Knowledge.

With which is incorporated Hardwicke's Science Gossip, and the Illustrated Scientific News.

A Monthly Record of Science.

Conducted by Wilfred Mark Webb, F.L.S., and E. S. Grew, M.A.

FEBRUARY, 1912.

THE GRAPHIC EXPRESSION OF SENSE.

By ANNA DEANE BUTCHER.

THE art of Typography has been, during the last twenty years, almost revolutionised. Entirely new processes have been invented, and it is claimed by the School of British Printing that it has made advances to an extent almost unparalleled in the recent history of any industry. Yet, with all these improvements in machinery and appliances, no similar ones have been made in the notation of the English language for four centuries, and we are confronted almost every hour of the day with the anomaly of a fifteenth-century print to express the complicated ideas, and define the accurate scientific conceptions, of the present day. Writing and printing as practised by civilised man are degenerate graphic arts, and while very much thought and money have been expended on mechanical precision, this most obvious fact has been overlooked, that if a drawing or symbol is unsuited to indicate sense or meaning, it is not only useless, but misleading, to ornament it or render it attractive to the eye.

It may be objected that "suitability" is a matter of opinion and taste, but this is not the case. The Ogee curve as assumed by the swan's neck is a beautiful because a suitable form; a walking-stick designed on this model would be a hideous object, because this form is wholly unsuitable to suggest strength or support. The laws of graphics or the expression of sense by the graphic arts are, like other physical laws, the ascertained causes of invariable phenomena.

It was the opinion of the late Professor Max Müller that until Language is studied as a physical, rather than an historical science, no practical improvement can take place in the means adopted by man for the expression of his thought or meaning.

The methods of investigation employed by the physicist are to accurately observe objects, to record facts and phenomena in their order of importance statistically, and then gradually, by the aid of the imagination, to guess a cause or invariable law which might account for the recurrence of these phenomena. He then proceeds to eliminate one after another those hypotheses which do *not* consistently explain the phenomena, until the true, or at least a workable law is discovered.

Following this scientific order we may deduce the following graphical laws.

Man is a silent-reading animal who draws his ideas.—This definition of man is as true now as in the hieroglyphical age of the ancient Egyptians. Man has the power of communicating his ideas by speech, in common with many other animals, but as far as we know there exists no other creature who draws his ideas.

Therefore writing, or symbolism, is just as inevitably a natural product as the honey of the bee, the coral island, or the spider's web. Graphic symbolism is a function of the brain of man. Symbols control his actions, are photographed upon his brain, are associated with all his intellectual efforts, and from their influence he can by no means free himself.

Man has been from time immemorial a slave to the traditional symbols which he employs; he has no more power to change these symbols than a magpie has to alter the shape of its nest.

Notations grow like trees, in accordance with graphical, which are physical laws. The brain of man is developed, and its nervous telegraph apparatus is differentiated and taught to function, by the traditional symbols which surround him on all sides. But man is not aware of this slavery. The mathematician imagines himself free to construct theories, to develop his ideas at will, and to express them as he chooses, little thinking that he himself is a slave to traditional symbols and absolutely dependent upon a paper memory for his calculations, and that were

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it not for happy accidents of notations, mathematical science would not exist. The mechanical trick of placing two little horizontal straight lines one underneath the other suggested the idea of negative numbers, and is the origin of the Binomial Theorem.

All the absurd explanations of teachers and textbooks are due to ignorance of the fact that the sign or mark precedes the idea. Sciences, Religious Philosophies, both false and true, owe their origin to symbols, yet no subject is so persistently disregarded as the natural history of man as a "symbol-drawing animal." The graphical expression of meaning is now no longer under the control and subject to the correction of the hand of man, but this function has been delegated to a number of mechanical contrivances, which are controlled automatically by mindless animate and inanimate forces *not* in harmony with the author of the idea. By the division of labour with the aid of these mechanical contrivances the daily progressive degeneration of the symbol goes on just in proportion as the machinery used is perfected. Thus the modern printer, with the assistance of the type-founder, covers the page with dots, tags, serifs, ornaments, finials, and marks of all description and in any situation, which are not intended to denote anything at all. The degeneration due to mechanical repetition can be traced back to the copyists of early manuscripts, who, not understanding the meaning of superscript marks, inserted them anywhere as ornaments to the script.

The stultifying effect of the machine upon the human intellect can be seen in that chapter of history which treats of the destruction of the symbol by the printer. Can anyone doubt, that had the expression of meaning remained under the control of the hand of the author, so indispensable a sign as one for accent or emphasis would, after the invention of many symbols to express it, and the survival of the fittest of them, be in universal use at the present day. The first Italian printers imitated the written characters, *i.e.*, the hand still dictated the shape of the letter: but the passion for mechanical uniformity which characterises common workmen of all ages, and more especially the printer of the present day, soon gave rise to the modification and distortion of the letters. As an example may be adduced the degeneration of the letter e in England. In Caxton's type this letter ɐ was a straight-backed looped letter with a dot in the middle. It was called *èe* and associated with the favourite vowel sound of the Anglo-Saxons, *i.e.*, the *i* sound in the word machine. But Caxton's types were clumsy, and not made with that mechanical accuracy which distinguished the Continental presses. It was therefore found convenient to discard these types and adopt the Roman characters, which were wholly foreign to the Gothic languages, and in many cases not suitable to express their sounds; thus the open round-backed *e* was adopted, which had on the Continent a definite phonetic association.

From the international misunderstanding resulting from this unfortunate substitution we have suffered up to the present day. The further degeneration of the type may be seen in the present fashionable letter e, which resembles a "nulla" or cypher crossed out, and has therefore been deprived of all character and power to express either sound or sense.

Signs of the revolt of the masses against the tyranny of the printer may be seen all over London on every hoarding, in every advertisement, and even in the tickets in the shop windows. All ignorant of the natural instinct which prompts him to rebel, the business man evinces his dissatisfaction with the monotonous, inexpressive, machine-made medium of intellectual communication which he orders from the printer, for which he pays so heavy a price, and which he is obliged to use whether it is suitable to his necessities or not.

The author thinks, the professor writes, the teacher teaches, the pupil copies, and the examiner records, exactly in the terms which the printer chooses to dictate.

The playwright must not instruct the actor as to what he wishes him to say, for the printer does not supply phonetic type.

Orators are requested *not* to be emphatic, for the printer does not choose to denote emphasis.

The singer has no guide to the pronunciation of his words, the traveller no help in foreign countries, the merchant no means of selling the goods which overstock the native market.

The foreigner has no key to the cypher in which the printer disguises the English literature, and what is termed "Elementary Education" is the explanation during three years of "Printers' Errors."

An article in Caslon's Calendar for 1887 contains a recognition of one of the printer's heresies. It is as follows:—

"The time has come when we are obliged in the face of demonstration to confess ourselves mistaken, affording one more instance of the folly of dogmatising on the possibilities of invention."

Let us take this recantation as an omen, foretelling the extinction of the present dumb, rule-of-thumb print, and the gradual introduction of a graphic system of expression based upon a geometrical key, which script may be translated into speech.

This new print will not be machine-made, but a product of the hand, eye, ear and voice, trained in unison, manufactured and supplied by the intelligence of the modern printer.

Wholesale reforms are very dangerous.

It is easy to destroy what cannot afterwards be restored.

Printing reform is loudly called for, but it must be founded on accurate knowledge of the associations which already exist between sign, sound and sense, and must not be the acceptation of any private cypher which any number of persons agree to adopt, where the signs chosen are *not* in accordance with natural law and traditional custom.

The following specimen of the Orthotype Notation, devised by the writer, illustrates the subject:—

THE RELIGION OF KNOWLEDGE.

An extract from "The Life of the Bee."

By MAETERLINCK.

"To discover the unconquerable duty of a living being is less difficult than one imagines: it is ever to be read in the distinguishing organs, whereto all the other organs are subordinate. And just as it is written in the tongue, the mouth, and the stomach of the bee that it must make honey, ... so in our eyes and ears and marrow, in every lobe of our brain, in every nerve of our body, it is written that we have been created in order to transform the forces we absorb from the earth into an energy of finer form and rarer quality. No other animal has thus been fashioned to produce this strange and subtle fluid, which we call thought, intelligence, understanding, reason, soul, spirit, cerebral force, virtue, goodness, justice, knowledge, for it has but one essence under a thousand names.

For the production of this essence all else has been sacrificed, ... our muscles, our health, the agility of our limbs, and the equilibrium of our functions: its growth endangers the very peace of our existence. This is the highest and most precious state to which matter or force can be raised. Flame, heat, light, nay life itself, and instinct more subtle than life and all the forces which ruled the world before our advent, have paled before its coming.

Let us not torment ourselves to know who will benefit by the energy which is accumulated at our expense. The bees know not if they shall eat the honey they have harvested . . . and we are equally ignorant as to who will profit by the spiritual energy which we are introducing into the universe.

As the bees go from flower to flower, collecting more honey than they or their offspring will ever need, let us go from reality to reality, seeking aliment for this incomprehensible flame . . . . . Let us

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nŏurish thiṡ ṡàcrɛd fire on our ṡɛntiments and paṡṡions, on åll wɛ ṡɛɛ or hɛar or tŏuch, on itṡ òwn ɛssence which is thɛ ïdëă it derìves from the discŏveries, ɛxpërïencɛs, and observàtions which resŭlt from itṡ contact with thɛ ɛxtĕrnal wŏrld. A time will thɛn cŏme whɛn åll things will turn ṡò nátùrally tơ gơod, in a ṡpirit that has given itsɛlf tơ the lòyal fulfĭlment ơf thiṡ ṡimple dùty, that the vɛry ṡuspíc͡ion ơf the possible aimlɛssnɛss ơf itṡ ɛxhåustiŋg ɛffort, will ònly rɛnder the dùty the clɛarer, ... will ònly add mòre pùrity, power, diṡinterɛ́stɛdnɛss, and frɛɛdom, tơ thɛ âdoŭr with which it still ṡɛɛks tơ "Knòw".

ᵔ denotes a mute letter. ´ denotes stress, accent, "loud." ` denotes a contracted diphthong, "long."

) = aw	ᶜ = ɛ	ᵕ = u	¯ = ơơ	ˈ = o	^ = ah	· = i	¨ = ï
awe	hɛn	us	fơơd	on	ah!	in	marine
åll	ány	lŏve	prōve	wȧs	fȧr	bùsy	machïne

The Phonetic values of the Phonographic Signs are seen in the words given above.

ᵕ = sh	s = z	ṡ = ss	c = ṡ	c k ɋ = c k q	r = ur	ph = f
ơf = of	ɡ = dj	ŋg = n	ɛ = ee	ɛ = e ȧ = ah	ơ = oo	ch = tsh
rɛad = reed	rɛad = rɛd	tơ = twơ = tơơ	fȧr,	ɋuɛɛn	cat	kiŋg

The omission of the "serifs," or the dot, in the case of i makes the letters (l, h, g, ɪ) mute.

The problem of International English is solved by the Orthotype Notation, which brings the phonetic element of the language up to date; that is, to the reign of Edward VII. It affords the printer an opportunity of taking his part in the education of his countrymen, and is the only answer hitherto offered to the question how to give the additional information necessary for the child and the foreigner, without destroying European idiography and without annoying the adult Englishman who knows, or thinks he knows, how to pronounce his own language.

Read with a pointer and hide the letters (a, e, ɪ, o, u, y) below the Phonographic Signs: ᵕ ᵔ ( ) ¯ ^ ˈ . ..

The church wȧs a ɡɛm rŏugh and òld
Sɛt in ʝēwɛls åll grɛɛn ȯr ơf gòld
Yơu cȧn't fail tơ sɛɛ how it stơơd
Fȧr awày at the side ơf the wơơd.

All the vowel sounds of the language are heard and seen in these lines.

The principle of printing reform is to associate the sound with part only of the letter, and if more than one letter is used to express one sound, a part must be chosen which is common to all of them, thus the dot on the right hand denotes the gutteral sound of c, k, ɋ.

An "Educational Print" in this form will serve as a standard for other styles of printing. The ordinary newspaper or journal whose end is the dustbin, the text book which serves a passing generation and expires in the second hand bookshop, may well be printed in the ordinary contracted form, but words like those of the great philosopher, Maeterlinck, classical literature, and all books which serve the purpose of copies for imitation by the child and the student, should be presented to the public in a form worthy of a scientific age.

THE NEW ASTRONOMY.

THE SUN.

By PROFESSOR A. W. BICKERTON.

The Approaching Solar Eclipses.

I DID not intend to amplify my tentative views of the problems relating to the Sun and to Comets, as given in "The Birth of Worlds and Systems," but the phenomenal number of naked-eye comets in 1911 and the approaching eclipses of the Sun have caused a good deal of attention to be directed to the Sun and to Comets. At the meetings of the British Astronomical Association a number of papers have been read and questions asked regarding these two subjects. Many enquiries have also been addressed to me personally, and hence I think, as the physics of the third body seem to throw much light upon most of these questions, that an amplification of the suggestions made in my books regarding the physics of the Sun and Comets, will be of value. I shall not at present deal with the genesis of the Solar System, as I still believe that the Moons and Planets were captured, as I described in my papers in 1879 and 1880, and I have made no very exhaustive study of this part of the New Astronomy during the last few years.

In thus presenting a working hypothesis relating to the physics of the Sun and Comets, I wish it to be understood that these suggestions do not stand in line with the first four articles on the New Astronomy. Most of the matter of these articles consists of deductions absolutely demonstrated to be true by the indisputable nature of the observational evidence that has accumulated.

From a photograph taken at the Royal Observatory, Greenwich.

FIGURE 49. Sun Spots, July 31st, 1906.

The Sun and its Surface.

The Sun, the ruling orb of the system of planets of which our Earth is a member, is a revolving blazing ball of fire, of such size and intensity, that, were its heat kept up by combustion, it would require to be stoked with six hundred times the coalfields of the entire Earth every minute of its existence.

The great globe on which we live takes us some two months to travel around it. It has a mass of some six thousand millions of millions of millions of tons. The vast solar furnace is more than a million times the size of the Earth. So intense is the internal heat and pressure of the Sun that the inner gases of which it is composed must be moving with such speed and under conditions that the molecular velocity must give its interior a dynamical rigidity of some thousand times that of the strongest nickel steel. Its surface temperature is something like 10,000° C.; so hot that the most intractable substance known on Earth would be fused and volatilized. The clouds of carbon that at one time were supposed to form its photosphere could no more exist in the solid form at the solar surface than could ice remain solid in a kitchen fire.

Surface Storms and Sun Spots.

The flames of this stupendous bonfire often leap upwards from its surface some scores of thousands of miles. On special occasions some of these vast tongues of fire have been seen towering above the limb of the Sun to a height of some hundreds of thousands of miles. Vast cyclones and other storms break into the general glow of its brilliant surface and produce dark spots; many of these sweeping whirlwinds of flame are so stupendous, that the great globe, our dwelling place, might drop into one of them with no more comparative effect than a chestnut in a cottage fire.

The Sun's Rotation.

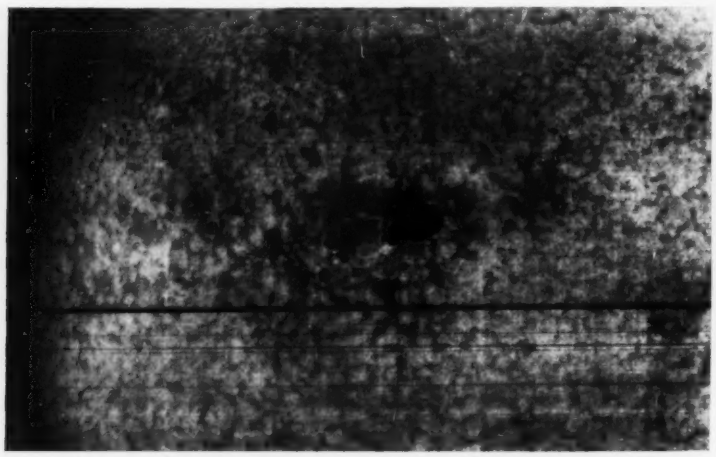
In addition to these great flames and cyclonic storms, the Sun has many other characteristics that have been found hard to understand.

The Sun rotates in about thirty days, yet his equator completes a revolution in something like two days less than the parts some forty-five degrees of latitude away.

Thus a sliding action must be occurring among its gaseous constituents, adding greatly to the tumult of its surface.

THE PHOTOSPHERE, REVERSING LAYER AND CHROMOSPHERE.

The main luminosity of the Sun originates in a surface of intense brilliancy, called the photosphere. This is probably the limit of aerostatic pressure; all above it being dynamically supported. First, there is a rare kind of atmosphere of metallic vapours some six hundred miles thick. It is called the reversing layer, because in it appear to be the elements that produce the chief dark lines of the solar spectrum. Above this again is a still rarer layer of an atmosphere of hydrogen and other excessively light gases. This is called the chromosphere, because of its reddish colour. It appears to extend some thousands of miles above the Sun's surface.



From a photograph taken at *Mount Wilson Solar Observatory.*

FIGURE 50. Iron Flocculi.

In addition to the eight planets and their satellites and the belt of asteroids, a vast luminous, apparently a meteoric, glow surrounds the Sun in the plane of the ecliptic. It is called the Zodiacal light. It is probably so extensive as to reach beyond the orbit of the Earth: for when we look in a direction away from the sun on a clear dark night we see it in the form of a glow called the Gegenschein. These myriads of particles would in this position be seen lit up by sunshine as the moon is when at its full.

THE CORONA.

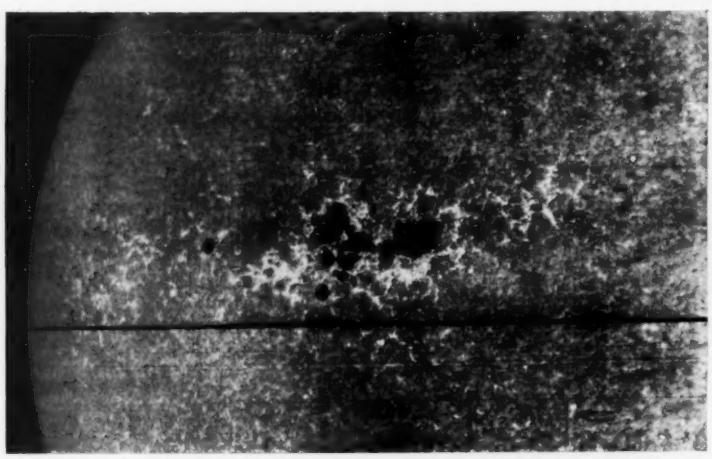
During a total eclipse, when for a few minutes the disc of the moon completely hides the face of the sun from view, not merely do we see the great red flames of glowing hydrogen and the vast volcanic ejections of blazing metals, but surrounding the black disc of the new moon are white shining rays of radiant light, looking like a superb encircling halo of auroral rays. This is called the corona, a kind of crown of glory, seeming to tell of the ruling power of the majestic monarch whose potency controls the giant globes that form the subjects of his mighty kingdom.

Such is the Sun. What are the forces, agencies, and potencies that control his speed of combustion; that produce his storms and tempests? What is the character of the mechanism that is the cause of his superb grandeur? What are the laws of nature laid under contribution to urge and regulate this seething mass of blazing gas? How can convection act to bring heat from the interior of a mass a thousand times as rigid as the strongest steel?

What pushing force can be at work urging the equatorial surface of gas to slide over and move faster than the general mass of the Sun? What originates the great solar storms and what motive power keeps for days and sometimes weeks, those tremendous tornadoes, sweeping the surface of that vast glowing furnace? What forces are at work keeping up the reversing layer and chromosphere? Why do they not collapse and sink down on to the Sun's static surface?

What are the agents that create the volcanoes that emit the vast red protuberances, and the still more wonderful metallic flames. What causes these tongues of fire, that leap upwards with velocities of hundreds of miles a second, sometimes towering to a height of hundreds of thousands of miles?

There are many other questions that face the solar student, and although some of them may not in the present state of our knowledge be answered, all at least are capable of receiving intelligible



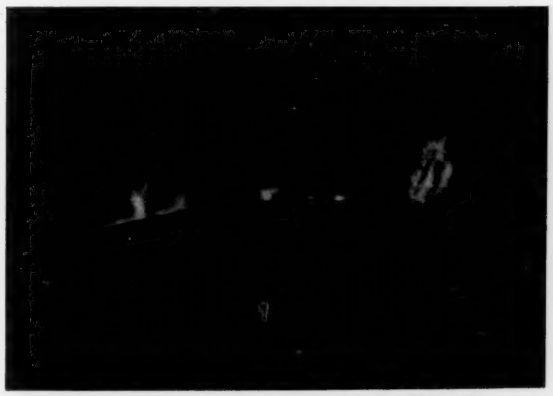
From a photograph taken at *Mount Wilson Solar Observatory.*

FIGURE 51. Hydrogen Flocculi.

suggestions of solution; suggestions that the diligent observers of solar phenomena may amplify, confirm or disprove.

THE COMING ECLIPSE OF THE SUN.

The approaching eclipse is one that should be utilized to put many of these suggestions to the test. These physical inductions and deductions should be used as working hypotheses to tell what work should be done in the flying moments of that supreme astronomical event, the forthcoming total eclipse of the Sun. For we have to remember that, although our Sun is a very insignificant little Sun amidst the giant orbs we call the stars, he is hundreds of thousands of times the nearest star to the Earth, and hence possibly capable of suggesting information as to the physical constituents of the giant suns of the firmament even better than those distant orbs can tell us by their own atomic songs, as we read them in the rainbow-tinted streak, the cypher message of the wondrous story. Hence, the problem of the Sun is the supreme problem of the whole range of astro-physical research.

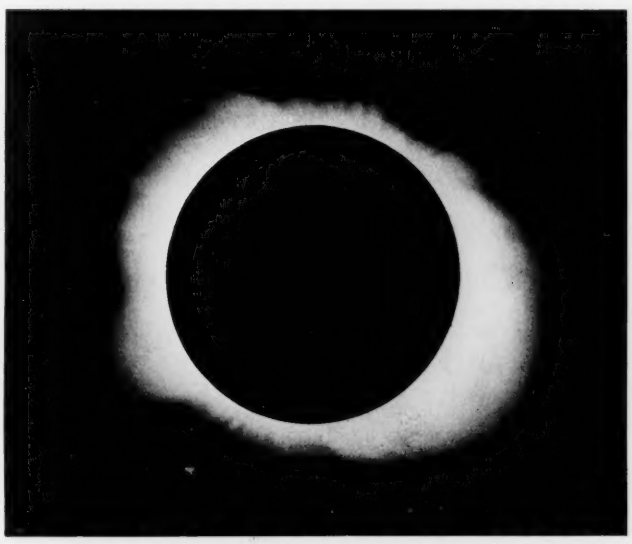


From a photograph taken at Chabot Observatory.

FIGURE 52. Solar Prominences.

HOW THE HEAT OF THE SUN IS KEPT UP.

There is very little doubt but Helmholtz's suggestion that the Sun's heat is kept up by compression is true. The fall of molecules is the dynamical source of the Sun's heat. The surface molecules radiate heat and lose speed, and the gravitating power of the Sun draws them nearer to his centre, and as they fall into this new position their speed increases. It becomes so much greater than it was before, that the entire temperature of the Sun gets higher. Thus we have the paradoxical fact that the Sun gets hotter the more heat it loses; that is, as long as it remains in the condition of free gas. It may be shown that a free gaseous sphere doubles its temperature when it is reduced to one half its diameter; that is, to eight times its original density. There is far more heat generated by this enormous compression than would double the temperature of the gas, but a large ratio is dissipated as radiant energy. The quantity of this ratio depends to some extent on the character of the molecules of the gas that is being acted upon. Almost certainly selective molecular escape is at work in all free gaseous masses, tending to sort the chemical elements so as to arrange them in such a manner that the heaviest are in the interior. The elements progressively lessen in atomic weight as we get further from the centre. At the surface itself we get the lightest of the elements, helium, hydrogen, nebulium, and so on.



From a photograph by E. E. Barnard.

FIGURE 53. The Corona, as seen in the total Solar Eclipse of May 28th, 1900.

SOLAR STORMS AND VOLCANOES.

Looking upon the problem as one of gaseous dynamics, it would seem as though, were there no external agent acting upon a mass of gas, that the surface would be much more smooth and subject to much less tumult than we find on the surface of the Sun. Most of the strange behaviour of material on the solar surface seems to receive a solution if we look upon the Zodiacal light as a vast meteoric appendage to the Sun, meteoric particles whose angular velocity is too great to allow them to be absorbed with the general shrinking gaseous material that forms the Sun himself. I do not propose now to give an account of my idea of the origin of the Sun and the solar system, other than to state that I look upon the collision that formed the Sun as almost a direct one, and that the whole of the bodies that revolve about the Sun were material that did not come into impact. They extended beyond the region of actual collision and whirled around at such a velocity as to be able to balance themselves in

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orbits. The large masses originated the planets, the selective action upon molecules and meteoric matter that would produce a system somewhat similar to the solar system, I have already discussed in some detail in the "Romance of the Heavens," in papers published in the "Transactions of the New Zealand Institute" and elsewhere.

The Energy of Meteors.

We will simply assume that the Zodiacal light consists of myriad millions of free meteoric particles, each revolving around the Sun in an independent orbit. Many of the orbits would be highly elliptical, and any particle that reached the surface of the Sun would do so with a velocity of the order of three hundred miles a second. It is extremely possible that in various ways these colliding meteors would act in the same way upon the inherent energy of the Sun as detonating caps act upon a mass of high explosives.

A particle striking the Sun with a velocity of three hundred miles a second would be possessed of an energy equal to at least a score of thousands of times its mass of dynamite. According to the angle they would strike the Sun, there would be considerable variation in the result. The great majority would strike the Sun tangentially in the direction of the Sun's own motion. From the distribution of the Zodiacal light it is clear that the orbit of such particles as struck very tangentially would mainly lie near the equator of the Sun, but as the plane of the solar equator differs by several degrees from the plane of the ecliptic, it would seem to deviate from that of the Zodiacal light, and impact would not be confined to the equator.

The Sun's Differential Rotation.

Every ton of such material would have an urging power upon the gaseous photosphere of the Sun, urging it forward with a pressure of over twenty thousand tons of exploding dynamite. It is also obvious that this effect will tell most upon the higher strata of the solar atmosphere, and that the differential velocity would consequently be greatest in the highest regions, and may account for the apparent fact that solar storms become more cyclonic the higher the region from which the photograph is taken. (See Figure 54.) Thus many of the anomalies of the Sun's differential rate of rotation seem to find a solution, if we consider the tremendous meteoric bombardment to which the equatorial regions are subject. It must be understood that it is not the equatorial rotation which is kept up by meteoric bombardment; it is merely the differential rate.

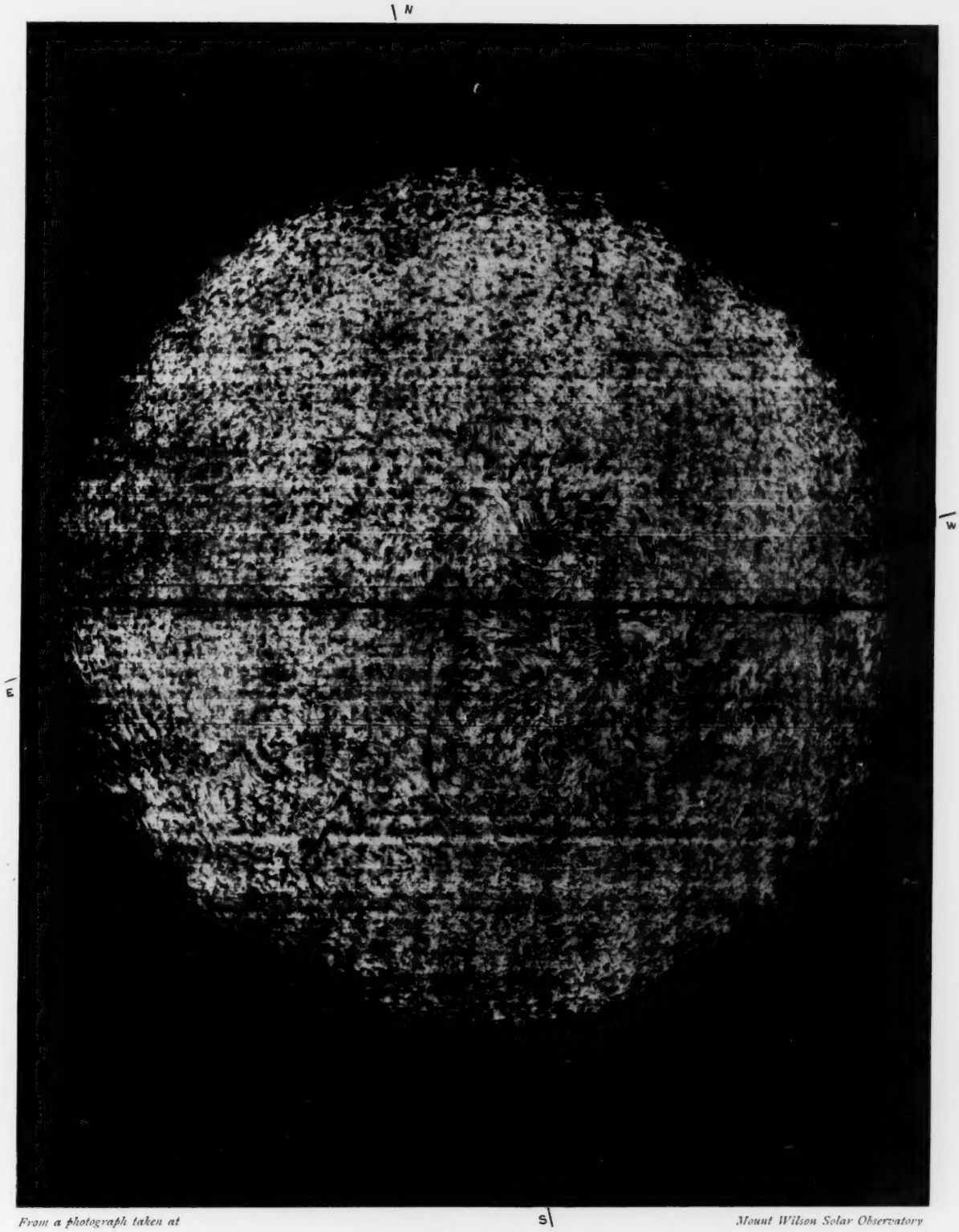
The Red Protuberances.

A meteor of moderate dimensions with a velocity of three hundred miles a second would develop heat sufficient to become completely volatilized at great heights in the solar chromosphere. It is a property of a mass of gas in motion to cause adjacent gas to acquire a motion also. This gaseous adhesion would entangle an immense quantity of the hydrogen of the chromosphere, and carry it down with it into the body of the Sun. As it would still retain an enormous velocity when it struck the surface of the photosphere, it would plunge to some depth below the surface, pressing the gases of the photosphere before it, and increasing their pressure so enormously, that when the velocity had spent itself an explosive reaction would occur, and the compressed gases of the photosphere would act as a violent explosive and blow the hydrogen that the volatilized meteor had brought with it to a vast height. Practically a volcano would be formed in the photosphere. (See Figure 52.) Sometimes the chief strength of this volcano would expend itself in blowing out vast flames of hydrogen, and the character of these flames would clearly depend to a large extent on the area of the disturbance, and on the angle at which the material was driven in on to the surface of the Sun. The strength of the explosion would be enormously greater than the energy possessed by the meteor itself, because the exploding volcano would produce a release of pressure from that portion of the Sun, and the extraordinary temperatures and pressure of these lower depths would exert themselves in carrying up a great deal more material than had been compressed.

In considering the effects of solar volcanoes we must remember that the great rigidity of the Sun is not a cohesion rigidity such as steel, but a dynamical rigidity, a rigidity of velocity, such as high-speed water, or a rapidly revolving chain in the form of a hoop, which will roll along the road exactly as though it were a hoop of spring steel.

Solar Meteors.

It is almost certain that large meteoric masses strike the Sun as they do the Earth. Brilliant flashes have been seen on the solar surface. These are often accompanied by magnetic storms and aurorae on the Earth. It is probable also that, unless the mass were gigantic, solar meteors would be largely volatilized before striking, and hence produce a broad field of impact. The ensuing explosion would eject it by pressure, and be followed by material from below, and this would again liberate lower material, until the opening would be so deep as to bring up metals of considerable atomic weight. The very factor of dynamical rigidity, that would tend to prevent ordinary convection currents, would actually be the agent in producing them when the downward-acting pressure was removed. At the same time this molecular motion would produce a lateral inrush that would tend to prevent the uprush extending to great depths, except in the case of the bombarding meteors being of very large mass, or a dense meteoric swarm. Such large impacts are probably the cause of the metallic ejections that sometimes reach hundreds of thousands of miles. The various angles of slope of the stream of material is probably due to different angles of impact.



From a photograph taken at *Mount Wilson Solar Observatory*

FIGURE 54.

The Sun, shewing Sun-spot Vortices rotating in opposite directions.

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SUN SPOTS.

I imagine that Sun spots have their origin in similar large meteors or meteoric swarms colliding and releasing the solar energy. The spot itself is probably the storm in the photosphere that follows the actual volcanic explosion; the dark spots, which are still intensely luminous, being due to expansion. The volcanic scar probably remains in its position on the Sun whilst the storm travels on the surface. The associated irregular luminous masses are probably regions of compression. Perhaps the uprushing hot material from the interior would also be more luminous than that which has expanded, cooled and is descending.

Spots are often associated together, sometimes long ranks appear at once. This may be due to bursting meteors, as we see them burst in the Earth's atmosphere, or they may be due to meteoric swarms with subordinate nuclei, breaking up under the Sun's differential tidal attraction. In connection with this point, photographs of comets' nuclei and of star clusters should be taken with very large telescopes to bring out and detect subordinate centres. Dynamically such subordinate centres seem certain sometimes to form in many swarms.

Whilst I think the general mottling of the Sun's surface to be due to Zodiacal meteors, I believe the larger Sun spots to be due to meteors that are parts of entrapped comets that have been torn to pieces by the Sun, comets entrapped by Jupiter and brought so close to the Sun as to partly impact. Schuster's investigations seem to me to point to the fact that more than one, perhaps many, comets have been so entrapped. The great eleven-year period suggests that a very large cometic swarm narrowly escaped complete impact and so became a forked double meteoric swarm. However, I do not want to give too much prominence to this tentative suggestion, as I have discussed the idea in some detail in "The Birth of Worlds and Systems" in "Harper's Library of Living Thought."

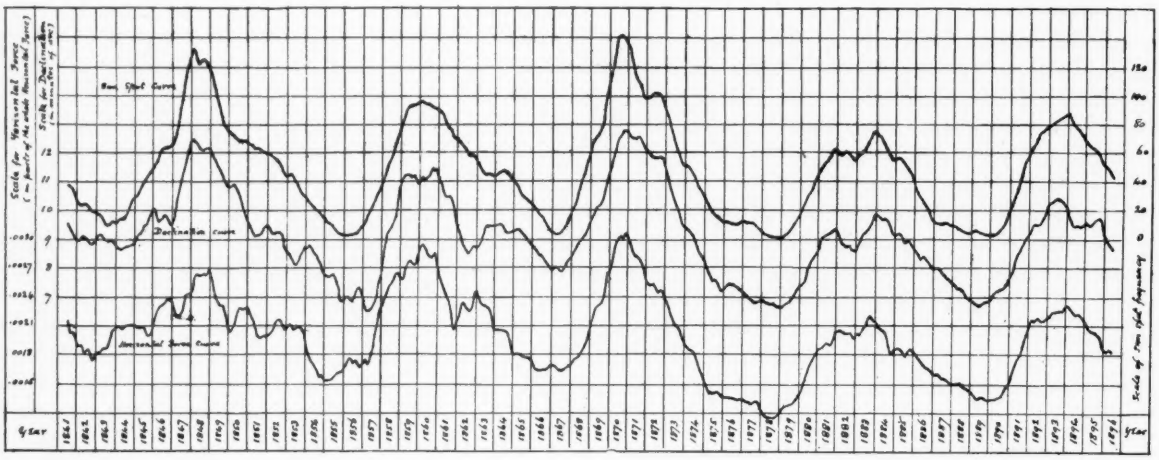
THE SUN'S LAYERS.

We have still to offer suggestions of explanations of the four ensphering luminous atmospheres of the Sun. The photosphere, the reversing layer, the chromosphere and the corona.

The idea that the photosphere is a carbon cloud formation, although very beautiful and a remarkably logical scientific induction, is probably not true, as the absolute temperature of the Sun's photosphere is almost certainly twice as high as that at which sublimed carbon can exist. I believe this intensely luminous envelope to be the surface of aerostatic pressure. The gravitation energy of the Sun, about twenty-eight times that of the Earth, must double the density of the surface gas at a very small depth. What this depth is it would be difficult to say, because temperature must increase enormously as well as pressure. The thermodynamics of the problem is very complex. I strongly suggest that, before trying to master this very popular account, students shall read the short statement of the dynamical theory of gases, and the contrast of gaseous pressure and kinetol as given on pages 106 to 109 in "The Birth of Worlds and Systems."

I take it, then, that the photosphere is the limit area of statical support. I shall try to show that all above this surface is dynamically supported, and does not follow the statical laws of the dynamical theory of gases as to pressure and volume. These layers are probably in rapid motion, and are supported by their high kinetol.

Although atom-sorting or selective molecular escape



Constructed by FIGURE 55. *W. Ellis.*

Smoothed Curves of Sun Spot Frequency (Wolf), compared with corresponding curves, showing the Variation in Diurnal Range of the Magnetic Elements of Declination and Horizontal Force, from Observations made at the Royal Observatory, Greenwich.

must always be acting, yet in such a seething mass as the Sun there would be mixing currents continuously acting; these would tend to bring the heavier elements to the solar surface. Yet the centre of every free mixed gaseous sphere will ever consist of elements heavier than the surface.

If we consider the photosphere to be the exterior limit of statically-supported mixed gases, and were the temperature to remain constant, the gases would double their density by pressure in one-eighth of a mile. That is, at a depth of a mile it would be two hundred and fifty-six times the density of the surface. Clearly, no matter how rapid the increase of heat, the statical surface of mixed gas would be quite definite. Were there no meteoric bombardment the surface would possibly be much smoother, and the dynamical rigidity of the Sun would largely prevent convection currents. Thus, the Sun would cool much more slowly than it does as it is. It would also last much longer. The detonating action of bombarding meteors, as it were, pokes the fire and makes it burn much more fiercely and causes it to give off much greater radiation.

The photosphere is consequently the very brilliant surface of solar equilibrium disturbed and rendered brilliant by convection currents due to impacts; the molecular speed of its dynamical rigidity being used to produce convection currents that bring the internal heat, produced by continuous compression, to the surface.

THE REVERSING LAYER.

This is largely mixed metallic vapours and gas probably projected upwards by convection volcanoes, chiefly produced by the small meteors of the Zodiacal light, aided also by the violent ejections produced by cometic meteors.

The reversing layer is about six hundred miles thick. Such thickness, if aerostatically supported, would acquire in its lower layer an inconceivable density. Yet it would appear its density is not many times greater in its greatest depths than it is near its exterior surface.

A mean velocity of ejection of ten miles a second would be amply sufficient to give a dynamical supporting power of six hundred miles.

It is probable that the chief absorption that produces the reversed lines of the solar spectrum lies mainly at the outer surface, where the mean velocity would be small. All the time the convection tongues were rising the lighter gases would be escaping from them; but practically all the mixed elements of the flame would reach the height the flame would be carried to by its velocity. Thus the apparent levitation of the reversing layer is the high kinetol it possesses in its emergence from the photosphere.

It is extremely probable that the bombardment of escaping electrons and radioactive emissions may help also to support the layers of the Sun outside the photosphere. It may also be aided by the pressure of light.

THE CHROMOSPHERE.

The surface of the reversing layer is the outer region of the mixed kinetol. Atom-sorting has been acting on its outer surface, and the high kinetol of the light elements will cause them to escape. These gases are the chromosphere. It seems to be chiefly hydrogen. The mean kinetol of this gas, as calculated, is four times that of helium, if both are in the monatomic state. Yet this is not necessarily true, for both helium and calcium are abnormal elements. They almost certainly dissociate into fragments; the evidence that calcium does so is very great indeed. And it is probable that these proto-elements, as Lockyer calls them, give especial spectra.

The chromosphere has a thickness of four or five thousand miles. Clearly it is dynamically supported. It is almost certainly supported by the high kinetol of these light elements or proto-elements.

I think that what is called the dusky veil is probably condensed material that has travelled to great heights and has radiated its heat, and temporarily assumed a cloudy form.

REVIEW OF LAYERS.

Thus, the photosphere is the natural statical surface of the Sun broken into rice-grain faculae, spots, and so on, by the detonation action of meteoric bombardment, these impacts liberating in turn the solar energy. The reversing layer is an ensphering shell of material carried up by the kinetol of these convection currents.

The chromosphere is light gas tinted with hydrogen, and supported by the high kinetol that light gases possess, compared with heavy gas at the same temperature.

THE CORONA.

The glorious radiation halo (see Figure 53) that shows itself as surrounding the Sun during a total eclipse is probably an electrical phenomenon, as I believe the tails of comets and the aurora also to be radiant beams induced by the electricity developed by the friction of the volcanoes of impacts and the convection currents so produced.

This induced electricity, acting on cosmic dust, lights it up. The character of the corona alters so regularly with Sun spot frequency as to leave no doubt the two are connected. Something like forty years ago, I published a paper in *The Philosophical Magazine* on a new relation between heat and electricity, that led me to the conclusion that the Sun is an electrified body. The disturbance of this by volcanic friction, I imagine to be the cause of the corona.

SUN SPOTS AND TERRESTRIAL MAGNETISM.

Terrestrial magnetism is probably due to induced currents of electricity produced by the Earth's rotation acting on solar induction. This is a constant action that is slightly increased or lessened by the

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action of Sun spots, and by the friction producing the flashes of light seen on the solar surface.

The coincidences of these two variables is very striking as shown by the accompanying diagram (Figure 55). Clearly it is conclusively proven. Earth auroras are also associated with the same phenomena.

CONCLUSION.

The Sun presents too stupendous a series of problems to be effectively dealt with in a single article. The foregoing ideas are offered as preliminary suggestions for the solution of some of them. Sufficient has been said to show the complexity, the wonder and beauty of the subject, and also its basic importance. Magnificent work is now being done by workers in many fertile fields of its varied researches. Some are taking photographs in special wave-lengths of varied elements, chiefly calcium and hydrogen. It will be seen by the accompanying pictures what wonderful information they afford of the ensphering solar surfaces. How clearly they show the cyclonic increase with altitude. We want all the information we can get. And the proposed solar observatory for Australasia should soon be a realized fact. For the wondrous skies of the Antipodes are singularly suitable, and the Sun is there showing his brightest when night reigns in England.

I hope that those about to be engaged in work connected with the coming eclipses will see if any of the above suggestions may serve as working hypotheses to guide their important researches.

In the next article I shall give some tentative ideas regarding the character of Comets.

THE TINTS AND SHADES OF AUTUMN WOODS.

By P. Q. KEEGAN, LL.D.

SEVERAL views, hypotheses, or opinions, based on experimental research, or otherwise, have been broached regarding the origin or production of the red, yellow and brown tints and shades exhibited by our forest leaves in autumn. The question stands next in interest, perhaps, to the cognate one as to the origin of the floral pigments, and, like the latter, it can be elucidated only by a consideration of the chemical facts which lead to an understanding of the physiological processes involved. That there is some intimate connection between the actual condition of vitality of the leaf at the autumnal period, and the particular tint or shade which it will then exhibit, can, I think, be fully demonstrated. There are, fortunately, two indisputable tests or indications detectable by chemical analysis which assure us to a certainty as respects this condition of vegetative activity. In the first place, we may compare the relative proportions of the special ministers of protoplasmic activity, viz., the albuminoids, in summer and in autumn; and secondly, by comparing the relative quantities of certain of the mineral matters (ash) present therein at the two stated periods respectively. Let it be observed at once that when the percentage proportion of albuminoid found in the autumn leaf is considerably less than that found in a similar leaf in summer, the conclusion may be drawn that the vitality thereof is sustained up till a late period; and when the case is reversed the inference is that there has been an early exhaustion of the vegetative activity. In other words, in the former case the albuminoids are mostly used up, and in the latter case they remain stored up in some inactive form or other. Similarly, also, with respect to the silica in the ash; an autumn leaf containing little silica is still alive, as it were, and *vice versa*. The following table is given in illustration of these facts:—

LEAVES RED IN AUTUMN.

	Albuminoid in Summer.	Albuminoid in Autumn.	Per cent. of Silica in the Autumn Ash.
Wild Cherry ...	6·7	0·76	3·3
Rowan	11·3	3·4	3·4
Birch	11	6·1	6·9
Elder	14·7	8·8	4·5
Pear	14·5	7	6
Scarlet Oak ...	14·4	7	4·3

LEAVES YELLOW OR BROWN IN AUTUMN.

Sycamore	20·3	20	20·7
Spanish Chestnut...	14·6	11	15
Hazel	17·3	16	11·6
Elm	17·9	16	28·8
Horse Chestnut ...	13·8	10	15·7
Black Poplar ...	17·3	14·3	10

The figures represent the percentages of albuminoid in the dried leaf.

It may also be noted that, in certain years and localities, oaks and beeches exhibit a very decent show of red, while, at the same time, the percentage of albuminoid falls below the normal, although that of silica may still remain pretty high, but in these instances the quantity of total ash is always low (about six per cent. in dry). Nevertheless, on a general review of the phenomena, it appears certain that where the protoplasmic albuminoid remains active till late, *i.e.*, in a more or less labile and soluble condition, the encroachment of silica upon the foliar tissues is checked, and the leaf assumes a bright red tint. The physiological processes are still vigorously sustained, and the cells retain both their water and their volume; but deassimilation predominates over assimilation, and hence there is more oxidation than reduction, more analysis than synthesis, a destruction of chlorophyll and a depletion of starch, a powerful accumulation of saccharine matters and glucosides; and finally, an especially strong and distinctive appearance of that crowning product of the foliar laboratory, named erythrophyll.

(To be continued.)

MEDICINES: ANCIENT AND MODERN.

By OLIVER C. M. DAVIS, D.Sc.

Lecturer in Materia Medica in the University of Bristol.

THE past fifty years has witnessed a very great activity among investigators in every branch of science, and the results of countless workers have been made use of for various purposes; it is highly probable that no art has gained such valuable knowledge through experimental research as that of medicine, which has been raised from gross empiricism to the proud position it now occupies. This satisfactory state of things has been brought about not only by direct chemical observations made by medical practitioners, but also by the chemist, physiologist, and bacteriologist in their respective laboratories. In early Egyptian times the practice of medicine lay in the hands of the priests, and was a sacred art surrounded by mysticism and superstition; it was then customary to use amulets (some of which were worn during life, and buried with the dead) and other charms as preventives of various forms of disease—forerunners of a scientific scheme of prophylactic medicine. (Figures 56–58).

FIGURE 56.
Amulets of the two fingers.

FIGURE 57.
Tet Amulets.

FIGURE 58.
Papyrus Sceptre Amulets.

The preparations for internal use up to the end of the fifteenth century consisted very largely of vegetable substances, and were chiefly characterized by the vast number of the ingredients which composed them; towards the end of that century Basil Valentine attempted to employ chemical substances in medicine, and actually recommended the use of antimony for fever (Malaria), and other diseases which we now term protozoic. The use of antimony has lately been recommended by Plimmer (1906). Shortly after, Paracelsus boldly stated that the object of the chemist was to prepare medicine, and not make gold—which was an alchemistic idea.

One of the first pharmacopoeias sanctioned by civil government was published at Nurnberg in 1545; it was largely based on the work of Galen, and some of the preparations therein contained are still in use. The first edition of the Pharmacopoeia Londinensis (1618), mentions one item, "Cranium humanum violente morte extinctum," which is sufficient to demonstrate that the apothecary's art was then surrounded by a veil of superstition: in the same edition was included the Theriaca of Mithridates which contained about two hundred and fifty ingredients. A most instructive and interesting contemporary work is "Burton's Anatomy of Melancholy," which in addition to mentioning all sorts of oils, liniments, plasters, and cerates, also sets forth the virtues of "sacks, bags, odoraments, and posies."

From this period, right down to comparatively recent times, an examination of medical works shows very clearly the absolutely empirical and unsystematic way in which medicines were compounded and administered; this is readily accounted for when we remember in the first place that the knowledge of the constituents of vegetable drugs was extremely vague and unsatisfactory; secondly, that reliable information regarding the action of drugs and their fate within the organism was almost entirely lacking, and last, but by no means least, the underlying cause of disease was seldom known. It is due to researches in these directions that our knowledge of the constitution of drugs and their physiological action has been progressing with a remarkable rapidity during late years.

In the chemical laboratory it has been shown that,

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under suitable treatment, natural products, such as leaves, roots and barks may be made to yield definite chemical compounds, amongst which are the alkaloids and glucosides; these have in many cases been very fully investigated both from the point of view of their chemical structure and their action on living organisms. Figure 59 shows six natural products from which powerful alkaloids are extracted; Aconite root and Calabar beans (obtained from West Coast of Africa) respectively contain aconitine and physostigmine, quinine exists in Cinchona bark, cocaine in Coca leaves, ergotinine in Ergot, and Nux-Vomica gives rise to the well-known substance strychnine. The vast strides in organic chemistry have also enabled the chemist to synthesise large numbers of compounds possessing a known structure and a known action — which action can frequently be modified by a modification of structure; these synthetic compounds have, after investigation, been classified according to their action as antipyretics, antiseptics, diuretics, hypnotics, and so on.

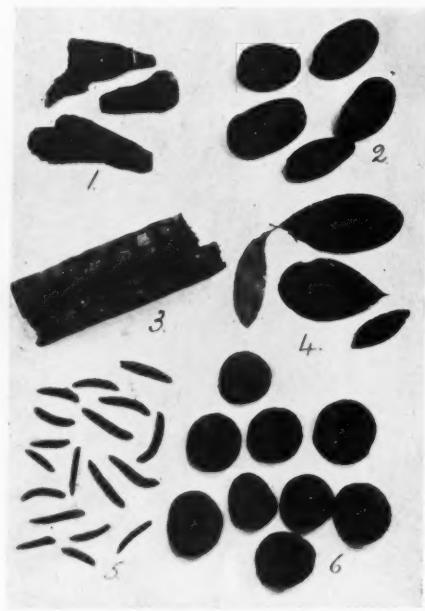

FIGURE 59.

1.—Aconite Root. 4.—Coca Leaves.
2.—Calabar Beans. 5.—Ergot.
3.—Cinchona Bark. 6.—Nux Vomica Seeds.

At the present time, therefore, instead of administering to his patient large quantities of indefinite and uncertain preparations containing numerous ingredients which may be chemically or physiologically antagonistic to each other, the physician is enabled to select some definite compound regarding which he knows both the chemical constitution and the physiological action: by subsequent observation of the patient he can ascertain whether the drug is acting in a satisfactory manner, and, if not, administer one of a different chemical constitution; but under the old conditions of "polypharmacy" it was a virtual impossibility to attribute the harmful or beneficial action of a preparation to any special ingredient.

As an illustration of the possibility of modifying the action of a chemical compound, the case of aniline and certain of its derivatives may be taken.

Aniline, which has very marked physiological actions, owes its activity largely to the presence of the benzene nucleus, and the view may be held that the "amino" group — NH_2, serves as an "anchoring group," and thus brings the molecule into contact with the protoplasm. It is far too toxic for satisfactory application as a drug, but by replacing one of the hydrogen atoms of the amino group by the "acetyl" radicle—$COCH_3$, we obtain a substance known as Acetanilide, or Antifebrin. This is very slowly hydrolysed within the organism, with gradual elimination of small quantities of aniline, which becomes oxidized in the body to para-amino-phenol, to which the physiological action is partly due, and may thus be used with a reasonable amount of safety as an antipyretic; the formulae in Figure 60 show very clearly how the molecule of aniline may be modified in this and other directions to give rise to medicinal products of varying structure and activity.

It is obvious that without a definite knowledge of the fate of a compound within the organism it would be quite impossible to modify the action of aniline as above described by administering it in the form of various derivatives. In a somewhat similar way, other synthetic preparations have been introduced, which are decomposed into definite products within the body.

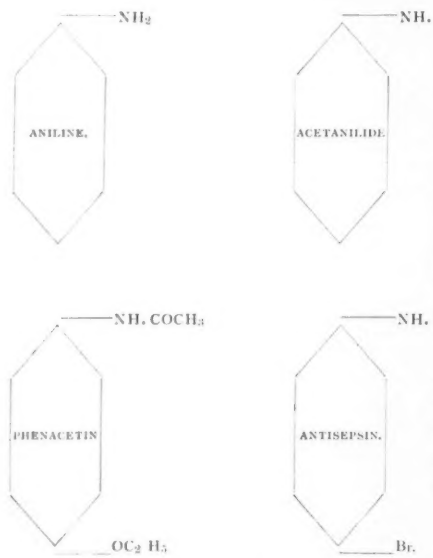

FIGURE 60.

Salol, for example, is the phenyl ester of Salicylic Acid, and in presence of the alkaline juices of the duodenum gives rise to salicylic acid and phenol or their salts, which act as intestinal disinfectants; a less toxic product, β Naphthol, may be similarly liberated in a "nascent" condition in the duodenum by employing the β Naphthyl Ester of Salicylic Acid, which is known as Betol.

Another drug of the same type largely and successfully employed, under different names, is Acetyl-Salicylic-Acid, which gives rise internally to Acetic and Salicylic Acids; such examples as this

make it obvious that the action of a drug may frequently be foretold by investigating its decomposition products and stability in the chemical laboratory. Whereas Acetanilide, as previously mentioned, has found an application in practical medicine, two compounds belonging to the same class, namely Formanilide and Benzanilide are quite useless, since the former is far too readily acted upon by reägents, and the latter under similar conditions is not appreciably broken down into reactive products. It has been shown by numerous workers that the stereo-configuration of an organic compound, *i.e.*, the spatial arrangement of the component atoms and groups may exert a profound influence on its chemical properties; thus the "ortho" and "para" toluidines (which differ only in the space relationship between the two substituent groups in the benzene ring), behave quite differently towards reägents, the former compound being the less reactive of the two; corresponding with this difference in chemical properties, the toxicity of the "para" compound is approximately twice as great as that of the "ortho" derivative. An important example of this phenomenon will be dealt with subsequently, when the treatment of sleeping sickness is discussed.

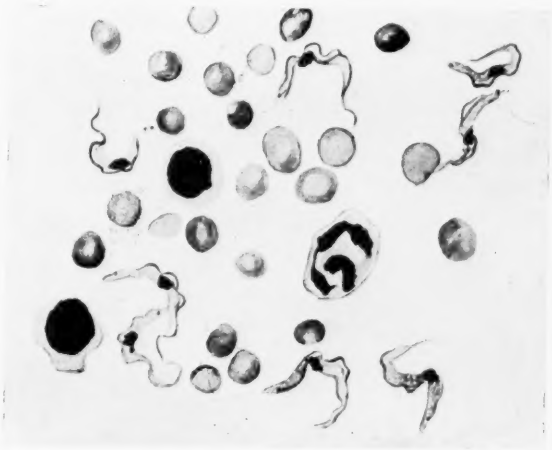

FIGURE 61.

Trypanosomes in Blood.

Photographed from an excellent drawing made from an actual specimen.

This increasing use of isolated active principles and definite chemical compounds in place of preparations of uncertain strength and indefinite action, is well demonstrated by a comparative study of the three editions of the British Pharmacopoeia, when it will be noticed that many of the old-fashioned concoctions are being gradually replaced by those which are rational and scientific in their composition. As an example we may take two classes of preparation typical of the old conditions of pharmacy, confections (electuaries) and decoctions—the former are semi-solid medicaments consisting of various drugs, chiefly of vegetable origin, mixed together with sweetening agents, such as honey, and the latter are made by boiling barks, roots, and so on, with water.

The 1864 Pharmacopoeia includes seven confections and thirteen decoctions; the 1885 edition, a much larger work, includes eight confections and thirteen decoctions, and the latest edition, published in 1895, mentions only four confections and three decoctions. In place of such as these there has been an introduction of increasing numbers of definite chemical substances into official pharmaceutical works; several such preparations, *e.g.*, certain alkaloids, ether, and chloroform, found a place in the first British Pharmacopoeia, and the last edition contains details regarding a number of synthetic compounds, among which may be mentioned Acetanilide, Phenazone, Salol, and Sulphonal.

Apart from the great advances in Pharmacology brought about by the researches of chemists and physiologists, there has been a distinctly forward movement on the part of pharmacists to place within the reach of medical practitioners galenical preparations of undoubted quality, strength and elegance, and this advance is largely due to the British Pharmaceutical Conference.

In the first edition of the British Pharmacopoeia, previously referred to, many tests are given for impurities in inorganic chemicals, but very few standards are set for drugs of organic origin; in the second edition there is a distinct improvement in this direction, which is maintained in a striking manner in the latest edition, in which directions are given for the accurate standardization of a considerable number of tinctures and extracts—such as those of nux-vomica, opium, belladonna and ipecacuanha, which contain as their active principles poisonous alkaloids. In one special case—nux-vomica—the preparations are adjusted to contain a definite percentage of strychnine instead of total alkaloids, since it has been found that this alkaloid is far more toxic and active than those with which it is associated. In cases where no official standard is set, various workers have described satisfactory methods for obtaining uniform standards, which are adopted by the leading manufacturing chemists. While methods of chemical standardization are very desirable, yet, in some instances, they are not quite satisfactory, and in such cases physiological methods are used; this applies more especially to those preparations derived from digitalis, ergot, and strophanthas, where an inactive drug might be responsible for most serious results. All this valuable information with regard to the structure and pharmacology of drugs would be of little use in practical medicine but for the great accumulation of knowledge regarding the cause of many diseases. In this direction Lord Lister, Pasteur and Koch have done pioneer work in proving conclusively that definite diseases are frequently associated with definite micro-organisms termed bacteria or bacilli. which must be exterminated to effect a cure. It

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has also been shown that certain diseases are caused by a larger species of micro-organism known as protozoa which find their way by various means into the blood of human beings or animals and bring about pathological conditions. Drugs which act by destroying such micro-organisms are known as "specifics," and to this class belong quinine, arsenic, antimony, and mercury. Quinine, the specific for malarial fever, was introduced to European pharmaceutics soon after the discovery of Peru, and has been generally recommended since the successful treatment of the Countess Cinchon (1640), hence the name, "Cinchona," of the tree from which the drug is extracted. Of very great medical importance is arsenic, especially those organic compounds which contain this element. An arsenic compound known as "Atoxyl" has been successfully used in the treatment of sleeping sickness. It is chemically known as Para-amino-phenyl-arsenic acid, and is represented by the constitutional formula. (See Figure 62.)

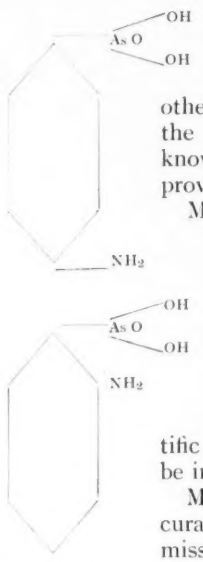


FIGURE 62.

The isomeric "ortho" compound has no effect on the sleeping sickness parasites (Trypanosomes); these are shown in Figure 61, in which they are seen in the form of elongated flagellated structures between red and white blood corpuscles.

The elaborate investigations of Ehrlich, Bertheim, Nierenstein and others on the action of atoxyl have led to the discovery of Salvarsan, commonly known as "606," which it is hoped may prove a specific for syphilis.

Mercury and antimony have a similar "specific" action, and the effects of some of the aniline dyes are very interesting, one of which, Methylene Blue, is used in the treatment of Malaria, in cases where the protozoa have been refractory to quinine.

It is to be hoped that as scientific research proceeds other specifics will be introduced into the practice of medicine.

My thanks are due to Mr. J. Quick, curator of the Bristol Art Gallery, for permission to photograph the amulets which are in his care.

THE ASTRONOMICAL SOCIETY OF BARCELONA.

A GENEROUS DONOR.

FORTHCOMING LUNAR EXHIBITION.

SINCE receiving the Royal favour a year ago this Society has considerably increased in numbers. The roll now contains four hundred names, and the Society is entering upon its second winter season with very rosy prospects. One of the objects of the Society, upon which special stress was laid at its foundation in January, 1910, was the provision of a public observatory where members might meet on fine evenings to study celestial phenomena, and to discuss points of astronomical interest. This, indeed, is the primary object of most societies of this nature, but it is seldom that it is realised. In the case of the Barcelona Society, as a matter of fact, although a reserve fund was accumulating with considerable rapidity, it was felt that it would be a very long time before the Society could acquire a suitable observatory. It is pleasant to record, however, that the primary object of the promoters has been realised very unexpectedly, and without cost to the Society, in such a manner that within the next few weeks the members will be in absolute possession of a well-equipped observatory.

Señor Rafael Patxot y Jubert, one of Spain's illustrious men of science, and a foundation member of the Society, has been so greatly impressed by the valuable work which is being carried on that he has offered to present his observatory and instruments to the Society, and, needless to say, the offer has been eagerly accepted. This establishment, "The Observatori Catalá," is situated at San Feliu de Guixols, in the province of Gerona, and in importance stands next to the observatories of Madrid and San Fernando. It has accomplished much valuable astrophysical work under the directorship of its owner during the past ten years, chiefly in the direction of the measurement of multiple stars. The whole establishment will be removed immediately to Barcelona, where it will be re-erected on the roof of one of the public buildings in a position easy of access to all members of the Society.

The dome, which is constructed of steel, has an internal diameter of seventeen feet, and was made by Messrs. Gilon, of Paris. It covers a fine double equatorial by Mailhat, visual and photographic, with apertures of eight and three-quarter inches, and focal lengths of ten feet and seven feet nine inches respectively. A complete set of accessories of precision is included in the gift, spectroscope, micrometer, camera, electric pendulum, and azimuthal theodolite. Annexed to the observatory in its new position will be a room for meetings of the Society, library, photographic laboratory, and so on. The Society realises that the best way to thank so generous a donor as Señor Patxot is to prove to him that his gift is appreciated to the fullest extent, and therefore one may confidently look for great things from Barcelona in the early future. One cannot speak too highly of disinterested generosity such as this, and whilst congratulating the Society on its good luck, one must also congratulate the donor, not only on his beneficence, but on his wisdom in choosing so deserving a body upon which to exercise his generosity. The value of the gift must not be expressed in terms of £ s. d., but must be reckoned by the amount of pleasure and instruction which it will afford to the thousands of people who will be privileged to use the instruments henceforward.

Preparations for the public Lunar Exhibition which will be held in Barcelona in May, 1912, are being pushed forward rapidly, and already many promises of assistance have been received from all parts of the world. The following gentlemen have accepted invitations to serve upon the honorary Executive Committee:—Messrs. Flammarion, Pickering, Frost, Campbell, Aitken, Hale, Ritchey, Antoniadi, Baillaud, Puisieux, Goodacre, Cerulli, Bolton, Diseilligny, de Azcárate, R. P. Cirera, Ricart y Giralf, Stroobant, and Weinek. The success of the Exhibi-

tion, therefore, seems assured. Among other exhibits already announced, the Lick Observatory promises to send a set of twenty sheets of the great photographic Lunar Atlas obtained by means of the thirty-six inch refractor between 1889 and 1895, together with a collection of transparencies on a large scale specially intended for exhibition in various countries. M. Puisieux has intimated that the Paris Observatory will be pleased to exhibit a copy of the Lunar Atlas which was the culminating point in the work of the late M. Loewy, and which represents one of the greatest triumphs of modern astronomical photography. On behalf of the Lunar Section of the British Astronomical Association, Mr. Goodacre will exhibit the superb collection of drawings recently shown at the Coronation Exhibition.

The Barcelona exhibition will be held in the University buildings, under the honorary presidency of the Rector, Baron de Bonet. The Executive Council of the Society invite the co-operation of selenographers of all classes in order to make this exhibition, the first of its kind, a great success, and with this end in view, the Secretary would be pleased to receive promises of assistance from any readers who may be able to contribute exhibits, no matter how modest, bearing on the subject. All communications should be addressed to Señor Don Salvador Raurich, Calle Gran Via Diagonal, 462, 2°, Barcelona, Spain.

WM. PORTHOUSE.

SOLAR DISTURBANCES DURING DECEMBER, 1911.

By FRANK C. DENNETT.

A FARTHER falling off in solar activity has to be recorded during December. Continuous observation has been hindered both by the low altitude of the Sun and the poor atmospheric conditions. On thirteen days (4, 5, 6, 7, 8, 9, 11, 12, 16, 17, 25, 27 and 30) the disc appeared free from disturbance, and faculae only seen on three (3, 14, and 19). At noon on December 1st the Central Meridian was 205° 21′.

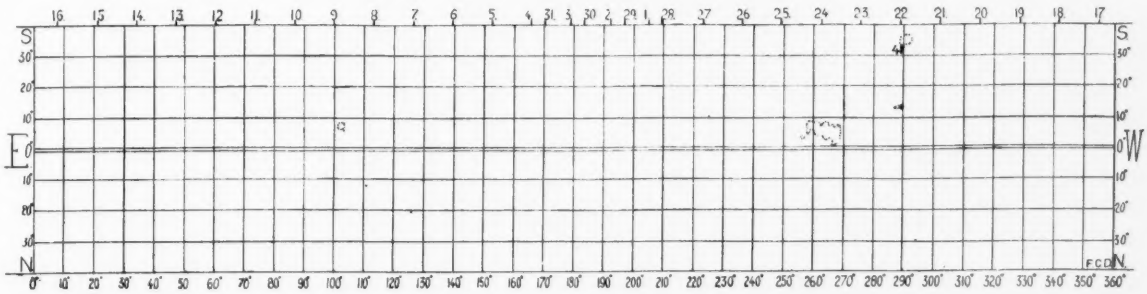
No. 41.—Apparently the only spot disturbance during the month. On the 20th there was a small spot found in the southern spot-zone, the leader of a trail of pores only 22,000 miles in length. When next seen, on the 23rd and 24th, it was as a solitary penumbraless spotlet with a ragged border, and which was quite gone by the following day.

The only other disturbances seen were faculic. On the 3rd such a disturbance was seen within the south-western limb, which must have been situated a little south-east of that shown on the monthly diagram on longitude 260°. On the 14th a small knot near the western limb, in longitude 102° marked the place where No. 39 had disappeared. On the 19th an extensive district streaked with faculae, around the site of No. 40, was visible within the eastern limb, reaching from longitude 258° to 269°. Again on the 24th there was a bright patch south of No. 41, in latitude estimated as being between 30° and 40°.

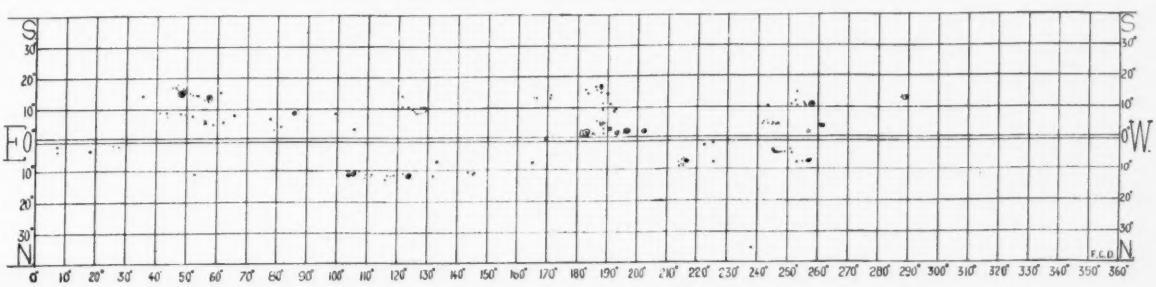
The only observers able to make effective telescopic observations were Messrs. McHarg, Buss, and Dennett.

Our second diagram shows the positions of the whole forty-seven spot disturbances seen during the year 1911, six of which were rather secondary or attendant outbreaks. Thirty-two were in southern latitudes, and fifteen in northern. The distribution of the disturbances is a striking feature. In the southern zone, between 35° and 130° there are fifteen outbreaks. Between 166° and 203° twelve more, with five between 241° and 263°, whilst situated by itself is No. 41, between 287° and 290°. Thus it will be seen that from 130° to 166°, 203° to 241°, 263° to 287°, and 290° to 35° the surface has apparently been quite free from spots. In the northern zone three small disturbances have occurred between 6° and 38°, seven between 103° and 170°, and five between 213° and 258°. The regions between 38° and 103°, 170° and 213°, also 258° and 6° in the northern hemisphere, have also thus been free from outbreak as well.

DAY OF DECEMBER, 1911.



DISTRIBUTION OF SPOT-DISTURBANCES, 1911.



THE FACE OF THE SKY FOR MARCH.

By A. C. D. CROMMELIN, B.A., D.Sc., F.R.A.S.

Date.	Sun.		Moon.		Mercury.		Venus.		Mars.		Jupiter.		Saturn.		Uranus.		Neptune.	
	R.A.	Dec.	R.A.	Dec	R.A.	Dec.	R.A.	Dec.	R.A.	Dec.	R.A.	Dec.	R.A.	Dec.	R.A.	Dec.	R.A.	Dec.
Greenwich Noon.	h. m.	°	h. m.	°	h. m.	°	h. m.	°	h. m.	°	h. m.	°	h. m.	°	h. m.	°	h. m.	°
March 1 ..	22 48·2	S.7·6	9 11·0	N.21·3	22 47·4	S. 9·7	20 43·4	S.18·4	4 41·0	N.24·4	16 50·7	S.21·7	2 53·4	N.14·4	20 16·2	S.20·3	7 31·5	N.21·2
,, 6 .	23 6·9	8·7	13 33·4	S.10·1	23 22·2	5·6	21 8·4	16·9	4 52·2	24·9	16 52·5	21·8	2 55·0	14·5	20 17·1	20·3	7 31·2	21·2
,, 11 ..	23 25·3	3·7	17 50·6	28·2	23 57·1	S.1·1	21 32·9	15·3	5 2·9	24·8	16 54·0	21·8	2 56·7	14·7	20 18·1	20·2	7 30·9	21·2
,, 16 ..	23 43·7	S.1·8	22 5·7	S.16·2	0 30·9	N.3·6	21 57·1	13·4	5 13·8	25·0	16 55·3	21·8	2 58·5	14·8	20 19·0	20·2	7 30·7	21·3
,, 21 ..	0 1·9	N.0·2	1 50·1	N.12·9	1 1·4	7·9	22 20·8	11·4	5 25·0	25·2	16 56·1	21·8	3 0·5	15·0	20 19·8	20·1	7 30·6	21·3
,, 26 ..	0 20·1	2·2	6 47·1	28·2	1 25·7	11·4	22 44·2	9·3	5 36·5	25·3	16 56·7	21·8	3 2·6	15·1	20 20·5	20·1	7 30·5	21·3
,, 31 .	0 38·3	N.4·1	11 34·7	N. 5·6	1 41·1	N.13·7	23 7·3	S. 7·1	5 48·2	N.25·3	16 57·0	S.21·9	3 4·7	N.15·3	20 21·2	S.20·1	7 30·4	N.21·3

TABLE 6.

Date.	Sun.			Moon.	Mars.						Jupiter.						Saturn.	
	P	B	L	P	P	B	L	T	Q	q	P	B	L_1	L_2	T_1	T_2	P	B
Greenwich Noon.	°	°	°	°	°	°	°	h m	°	"	°	°	°	°	h m	h m	°	°
March 1	−21·7	S.7·2	86·8	+16·5	−32·7	S.7·4	204·7	10 38 *e*	82·4	·78	+6·5	S.2·9	135·4	97·5	8 17 *m*	7 14 *e*	−0·8	S.21·3
,, 6	22·9	7·3	21·0	+19·8	31·8	6·4	156·9	1 15 *m*	83·2	·75	6·3	2·9	204·9	128·9	6 23 *m*	5 26 *m*	0·8	21·4
,, 11	23·9	7·2	315·1	+ 0·2	31·0	5·4	109·1	4 32 *m*	84·2	·72	6·2	2·9	274·4	160·3	2 20 *e*	7 34 *m*	0·9	21·5
,, 16	24·8	7·1	249·2	−19·5	30·0	4·2	61·2	7 48 *m*	85·2	·69	6·1	2·9	344·0	191·7	2 35 *m*	4 38 *e*	0·9	21·7
,, 21	25·5	7·0	183·3	−18·7	29·0	3·1	13·3	11 5 *m*	86·2	·65	6·0	2·9	53·7	223·3	8 22 *e*	5 59 *m*	1·0	21·8
,, 26	26·0	6·8	117·3	+ 5·0	27·8	2·0	325·3	2 23 *e*	87·2	·62	5·9	2·9	123·5	254·9	8 37 *m*	2 53 *e*	1·1	22·0
,, 31	−26·3	S.6·5	51·4	+21·8	−26·7	S.0·8	277·3	5 40 *e*	88·3	·59	+5·9	S.2·9	193·3	286·5	4 33 *e*	4 5 *m*	−1·1	S.22·1

TABLE 7.

m, *e* denote morning and evening respectively. Greenwich Civil Time is used throughout, the day commencing at midnight.

P is the position angle of the body's North Pole, measured eastward from the North point of the disc. B, L are the Heliographical or Planetographical latitude and longitude of the centre of the disc. In the case of Jupiter there are two systems of longitude, one for the Equator the other for the Temperate Zones.

T denotes the time of passage of the zero meridian across the centre of the disc. Intermediate passages for Jupiter may be found by applying multiples of $9^h\ 50\frac{1}{2}^m$, $9^h\ 55\frac{1}{2}^m$ for the two systems; for Mars apply multiples of $24^h\ 39^m$.

Q, q for Mars are the position angle and amount of the greatest defect of illumination.

THE SUN crosses the Equator and Spring commences at $11\frac{1}{2}^h$ *e* on March 20th. Its semi-diameter diminishes during the month from 16′ 10″ to 16′ 2″. At Greenwich it rises at $6^h\ 48^m$, sets at $5^h\ 37^m$ on March 1st; rises at $5^h\ 40^m$, sets at $6^h\ 29^m$ on March 31st.

MERCURY is too near the Sun to be seen at the beginning of the month, but is well placed as an evening star at the end

Date.	Star's Name.	Magnitudes.	Disappearance.		Reappearance.	
			Mean Time.	Angle from N. to E.	Mean Time.	Angle from N. to E.
1912.			h m		h m	
Mar. 3 ...	1 Leonis	5·3	4. 2 *m*	88°	4.50 *m*	334°
,, 4 ...	13 Virginis	5·9	7.46 *e*	149	8.37 *e*	272
,, 4 ...	η Virginis	4·0	8. 7 *e*	93	9. 0 *e*	331
,, 6 ...	BAC 4445	7·1	—	—	2.24 *m*	318
,, 9 ...	BAC 5220	6·7	—	—	2. 0 *m*	311
,, 9 ...	BAC 5253	5·4	4.21 *m*	123	5.41 *m*	282
,, 9 ...	BAC 5286	5·4	7.17 *m*	105	8.32 *m*	282
,, 10 ..	BAC 5595	6·9	—	—	2.48 *m*	16
,, 22 ...	δ Arietis	4·6	9.24 *e*	116	10. 5 *e*	216
,, 23 ...	36 Tauri	5·6	7.54 *e*	23	8.29 *e*	316
,, 23 ...	BD + 23° 624	7·0	9 39 *e*	120	—	—
,, 27 ...	BD + 24° 1903	7·0	9.20 *e*	170	—	—
,, 27 ...	λ Cancri	5·9	10.11 *e*	181	10.35 *e*	223

From New to Full the Disappearances take place at the Dark Limb, from Full to New the Reappearances do so.

TABLE 8. Occultations of stars by the Moon visible at Greenwich.

THE MOON is Full March $3^d\ 10^h\ 42^m$ *m*; Last Q., $10^d\ 7^h\ 56^m$ *e*; New, $18^d\ 10^h\ 9^m$ *e*; First Q., $26^d\ 3^h\ 2^m$ *m*. Apogee $13^d\ 5^h$ *m* (semi-diameter 14′ 46″). Perigee $28^d\ 9^h$ *e* (semi-diameter 16′ 15″). Maximum Librations: Feb. 29, 7° S.; March 6, 6° W.; March 13, 7° N.; March 21, 5° E.; March 27, 7° S.; April 3, 5° W. The letter indicates the direction on the limb of the region brought into view. E. W. are towards Mare Humorum and Mare Crisium respectively.

of it. Its semi-diameter increases from $2\frac{1}{2}$″ to 4″. The fraction of disc illuminated diminishes from 1·0 to 0·3.

VENUS is a morning star, badly placed for Northern observers. Its semi-diameter diminishes from $6\frac{1}{4}$″ to $5\frac{1}{2}$″, fraction of disc illuminated increases from $\frac{3}{8}$ to $\frac{9}{16}$.

MARS is an evening star, but its disc is very small; the semi-diameter diminishes from $3\frac{3}{4}''$ to $3''$. It is 3° S. of β Tauri on March 19th.

JUPITER is a morning star. Its polar semi-diameter increases from 17″ to $18\frac{3}{4}''$, the equatorial is $1\frac{1}{4}''$ greater. The defect of illumination is $\frac{1}{3}''$. The configurations of the satellites as seen with an inverting telescope at 4^h *m* are

Day.	West.	East.	Day.	West.	East.
Mar. 1	321 ○ 4		Mar. 17	31 ○ 24	
,, 2	32 ○ 14		,, 18	⊙ 234	
,, 3	3 ○ 24	1●	,, 19	2 ○ 134	
,, 4	1 ○ 234		,, 20	12 ○ 34	
,, 5	2 ○ 134		,, 21	3 ○ 124	
,, 6	1 ○ $\frac{3}{4}$	2●	,, 22	31 ⊙ 4	
,, 7	34 ○ 12		,, 23	32 ○ $\frac{1}{4}$	
,, 8	$34\frac{1}{2}$ ○		,, 24	$3\frac{1}{4}$ ○ 2	
,, 9	432 ○ 1		,, 25	4 ○ $1\frac{3}{4}$	
,, 10	4 ○ 2	3●1●	,, 26	42 ○ 3	1●
,, 11	41 ○ 23		,, 27	421 ○ 3	
,, 12	42 ○ 13		,, 28	4 ○ 312	
,, 13	41 ○ 3	2●	,, 29	431 ○ 2	
,, 14	43 ○ 12		,, 30	432 ○ 1	
,, 15	$31\frac{1}{2}$ ○		,, 31	$\frac{1}{3}1$ ○ 2	
,, 16	32 ○ 14				

Phenomena visible at Greenwich:—2^d 4^h 0^m I. Sh. I. 5^h 15^m I. Tr. I., 6^h 12^m I. Sh. E.; 3^d 4^h 17^m III. Oc. D, 4^h 47^m I. Oc. R. 6^h 13^m III. Oc. R; 4^d 4^h 55^m II. Sh. I; 6^d 4^h 18^m II. Oc. R; 9^d 5^h 53^m I. Sh. I; 10^d 3^h 14^m 27^s I. Ec. D, 3^h 16^m 57^s III. Ec. D, 4^h 58^m 57^s III. Ec. R; 11^d 2^h 34^m I. Sh. E., 3^h 49^m I. Tr. E.; 13^d 1^h 46^m 19^s II. Ec. D; 15^d 1^h 58^m II. Tr. E; 17^d 5^h 7^m 51^s I. Ec. D; 18^d 2^h 14^m I. Sh. I, 3^h 29^m I. Tr. I, 4^h 27^m I. Sh. E., 5^h 42^m I. Tr. E.; 19^d 3^h 1^m I. Oc. R.; 20^d 4^h 19^m 52^s II. Ec. D.; 21^d 1^h 52^m III. Tr. I., 3^h 47^m III. Tr. E.; 22^d 1^h 51^m II. Tr. I., 2^h 1^m II. Sh. E., 4^h 29^m II. Tr. E.; 25^d 4^h 7^m I Sh. I., 5^h 19^m I. Tr. I.; 26^d 1^h 29^m 37^s I. Ec. D., 4^h 52^m I. Oc. R.; 27^d 0^h 48^m I. Sh. E., 2^h 0^m I. Tr. E.; 28^d 0^h 51^m III. Sh. I., 2^h 50^m III. Sh. E., 5^h 38^m III. Tr. I.; 29^d 1^h 57^m II. Sh. I., 4^h 20^m II. Tr. I., 4^h 36^m II. Sh. E.; 31^d 1^h 5^m II. Oc. R. All these phenomena are in the morning hours. Attention is drawn to the almost simultaneous eclipses of I. and III. on the 10th. The eclipses occur high left of the disc in the inverted image, taking the direction of the belts as horizontal.

SATURN is an evening star, drawing near the Sun. Equatorial semi-diameter $8\frac{1}{2}''$; major axis of ring $39\frac{1}{2}''$, minor $14\frac{1}{2}''$. The times of some Eastern elongations of the Satellites are given; intermediate ones are found by applying multiples of 1^d 21^h for Tethys, 2^d 18^h for Dione. Tethys 3^d 4^h *m*, 8^d 8^h *e*, 14^d *noon*, 18^d 7^h *m*; Dione 2^d 8^h *e*, 8^d 8^h *m*, 13^d 7^h *e*, 16^d 1^h *e*; Rhea 4^d 4^h *m*, 8^d 5^h *e*, 13^d 5^h m. For Titan and Iapetus E., W., stand for E. and W. Elongations; I.S. for Inferior and Superior Conjunctions. Titan 5^d 7^h *m* I, 9^d 4^h *m* W, 13^d 2^h *m* S. 17^d 6^h *m* E; Iapetus 16^d 8^h *m* E.

URANUS is a morning star, but very badly placed. Semi-diameter $1\frac{3}{4}''$.

NEPTUNE is well placed as an evening star; semi-diameter $1\frac{1}{4}''$. A map of its course was given in "KNOWLEDGE" for December last.

COMETS.—Elements of Comet L 1911, discovered by M. Schaumasse at Nice, on November 30th.

T = 1912, Feb. 5·34, G.M.T.
ω = 109° 7′·6
Ω = 115° 12′·1
i = 20° 29′·4
log q = 0·06822

Ephemeris for Paris midnight:—

	R.A.	S. Dec.		R.A.	S. Dec.
	h. m. s.	° ′		h. m. s.	° ′
Feb. 2	17 37 31	S 21	March 5	19 40 30	11 11
,, 6	17 54 23	8 55	,, 9	19 53 42	11 19
,, 10	18 10 53	9 25	,, 13	20 6 22	11 25
,, 14	18 26 59	9 51	,, 17	20 18 30	11 29
,, 18	18 42 39	10 14	,, 21	20 30 9	11 32
,, 22	18 57 53	10 33	,, 25	20 41 15	11 34
,, 26	19 12 36	10 48	,, 29	20 51 53	11 35
March 1	19 26 50	11 1			

The comet is brightest at the end of January, but is then of only the 10th magnitude. It is a morning star.

METEORS.—The following list of showers is due to Mr. W. F. Denning.

Date.	Radiant. R.A.	Radiant. Dec.	Remarks.
Mar. 1-4 ..	166°	+ 4°	Slow, bright.
,, 14 ...	250	+ 54	Swift.
,, 18 ...	316	+ 76	Slow, bright.
,, 24 ...	161	+ 58	Swift.
,, 27 ...	229	+ 32	Swift, small.
Mar. to May	263	+ 62	Rather swift.

EVERY THIRD MINIMUM OF ALGOL (Period 2^d 20^h 46^m) March 1^d 10^h 16^m *m*, 10^d 0^h 43^m *m*, 18^d 3^h 9^m *e*, 27^d 5^h 36^m *m*.

DOUBLE STARS.—The limits of R.A. are 9^h to 11^h.

Star.	Right Ascension. h. m.	Declination.	Magnitudes.	Angle. N. to E.	Distance.	Colours, etc.
σ^2 Ursae Majoris	9 2	N 67°·5	5, $8\frac{1}{2}$	90°	$\frac{1}{2}''$	Greenish-yellow, blue. The position is uncertain, owing to rapid motion near periastron.
Lalande 17954 ...	9 2	N 23 ·3	6, 7	200	7	White.
38 Lyncis	9 13	N 37 ·2	4, 7	236	3	White, blue.
39 Lyncis	9 16	N 49 ·9	6, 8	320	6	White, blue.
21 Ursae Majoris	9 19	N 54 ·4	7, 8	313	$5\frac{1}{2}$	White, blue.
23 Ursae Majoris	9 24	N 63 ·5	4, 9	270	22	Greenish-white, Ash.
ω Leonis	9 24	N 9 ·5	6, 7	127	1	Yellow.
Groomb 1569	9 36	N 39 ·4	7, 8	290	3	Yellow, blue.
γ Leonis	10 15	N 20 ·3	2, 3	118	4	Golden.
Struve 1439	10 25	N 21 ·3	8, 8	110	$1\frac{1}{2}$	White.
49 Leonis	10 30	N 9 ·1	6, 9	156	2	White, blue.
35 Sextantis	10 39	N 5 ·2	6, 7	240	6	Yellow, blue.
Lalande 20799	10 43	S 14 ·8	6, 7 7, 8	17 198	69 } $6\frac{1}{2}$ }	Triple.
54 Leonis	10 51	N 25 ·2	5, 7	107	$6\frac{1}{2}$	Greenish-white, blue.

XUM

CLUSTERS AND NEBULAE.

Name.	R.A.	Dec.	Remarks.
♅ I. 205	9h 16m	N 51°·4	Large, oval, bright nebula with nucleus.
♅ I 56, 57	9 27	N 21 ·9	Oblique spiral nebula.
	9 39	N 17 ·1	Curious field nearly devoid of stars.
♅ I. 78	9 42	N 72 ·7	Bright nebula.
M. 81, 82	9 49	N 69 ·6	Two bright nebulae ½° apart.
♅ I. 163	10 1	S 7 ·3	Fairly bright nebula.
♅ I. 3, 4	10 10	N 3 ·9	Two faint nebulae.
♅ IV. 27	10 21	S 18 ·2	Bright planetary nebula.
♅ I. 86	10 23	N 29 ·0	Bright oblong nebula; 11 mag. nucleus.
♅ I. 17, 18	10 44	N 13 ·1	Two faint nebulae, some others near.

THE SOLAR ECLIPSE OF APRIL 17.—It will probably be convenient for those who propose to go to the central line in this eclipse to have accurate information sufficiently long beforehand to make their arrangements.

The following positions are based on a combination of the American Ephemeris with the Nautical Almanac, going $\frac{1}{6}$ of the way from the former to the latter. (The reasons for this course are given in the Journal of the B.A.A. for December.) T, A denote the probable durations of totality or annularity. It should be noted that the phrase "annularity" is really not suitable for France, as the appearance will probably be that of a few beads of sunlight at the Moon's edge, not of a continuous ring.

Longitude.	Latitude.	Duration.
9° 38'·7 W	39° 55'·6 N	1s·6 T
8 2 ·7	41 24 ·3	1 ·4 T
6 21 ·0	42 52 ·8	1 ·1 T
4 32 ·5	44 21 ·3	0 ·5 T
2 36 ·0	45 49 ·4	0 ·3 A
0 29 ·7 W.	47 17 ·5	1 ·3 A
1 48 ·3 E.	48 45 ·2	2 ·6 A
4 20 ·2	50 12 ·4	4 ·0 A
7 8 ·9	51 39 ·0	5 ·6 A
10 17 9	53 4 ·6	7 ·6 A
13 51 ·5 E	54 28 ·5 N	9 ·9 A

The track enters Portugal at Ovar, which was also on the central line in 1900, when it was occupied by the Astronomer-Royal, and many other English Astronomers. It passes eighteen miles due east of Oporto, enters Spain near the village of Verin, in Orense, passes seven miles due east of Villafranca, in Leon, two miles east of Oviedo, and leaves the peninsula some seven miles east of Gijon. According to the above figures it will cease to be total while traversing the Bay of Biscay. It enters France six miles S.E. of Les Sables d'Olonne, in Vendée, passing fourteen miles south of Angers, nineteen south of Le Mans (noted for aeroplane experiments), through St. Germain en Laye, in the western environs of Paris, very near Namur in Belgium, and onward into Germany and Russia. Details for the partial eclipse in the British Isles will be given next month.

CORRESPONDENCE.

SWEEPINGS.

To the Editors of "KNOWLEDGE."

SIRS,—Mr. Enock* evidently has misread Westwood's "Introduction to the Modern Classification of Insects," or he could not have written of *Elenchus tenuicornis* Templeton, of which but one example had hitherto been recorded over fifty years ago. In the text Westwood gives no author's name, but in the synopsis bound up at the end of the volume he gives it correctly *Elenchus tenuicornis* K. Moreover, in the few pages in which he deals with *Elenchus* and the other genera in the order *Strepsiptera*, he refers to specimens of this insect having been taken by Stephens, Dale, Haliday and Walker, in addition to that by Mr. Templeton (which he queries as belonging to another species *Walkeri* Curtis), and although he does not expressly mention the insect, he was obviously aware of the mutilated specimen on which Kirby based his description in 1811. There are thus no less than six separate and distinct captures of this species referred to in the volume consulted by Mr. Enock.

There has been considerable hesitation in admitting the claims of *E. Walkeri* Curtis to rank as a distinctive species. Mr. S. L. Saunders, in his monograph of the *Stylopidae* (*Trans. Ent. Soc.*, 1872), queried it, but very properly divided the records between the two species described, and the framers of our lists, with one accord, have refused to admit more than one distinct species, *E. tenuicornis* K. In the latest monograph of the *Strepsiptera*, written by W. D. Pierce and published this year in the "*Genera Insectorum*," the author elevates *E. Walkeri* Curtis to specific rank. He also adds the important fact that "*E. tenuicornis* K. is known to be parasitic on leaf-hoppers, probably of the genus *Liburnia*."

Mr. Enock is to be congratulated on his success after so many years' search, and it may be that with this hint he will be successful in elucidating still more of the life history of these wonderful, minute parasites.

BARNSLEY. E. G. B.

THE VELOCITY OF LIGHT.

To the Editors of "KNOWLEDGE."

SIRS,—In the October number of "KNOWLEDGE" you kindly published a letter from me suggesting that the Velocity of Light, should be re-calculated from observations to be made at different heights above the earth's surface, so as to see what retardation, if any, is caused in the velocity of light by the earth's atmosphere. My suggestion was founded on the fact that we can see a flash of lightning, which apparently usually passes from the thunder cloud to the earth; and because the human eye is not capable of seeing anything that passes across its vision in less than about one-tenth of a second, it seems to me that a flash of lightning takes more than one-tenth of a second to pass from cloud to earth.

As a thunder-cloud is seldom at a greater height than two miles above the earth, does not the flash of lightning take at least one-tenth of a second to travel this distance?

Mr. Charles E. Benham in the December number of "KNOWLEDGE," page 471, suggests that I was trying to hoax your readers. Nothing was further from my thoughts, and I will try to explain myself more thoroughly.

The filament of an electric light causes obstruction to the current of electricity flowing from the generating station, and the obstruction is so great that heat is generated and the

[* In an article entitled "Sweepings," KNOWLEDGE, Volume xxxiv., page 400, Figure 2 was by an accident labelled "female," instead of male, after Mr. Enock had passed his proofs.—EDS.]

filament becomes red or white-hot. If the wires conducting the current were continuous, there would not be friction sufficient to cause heat or light, so that in passing through the filament the velocity of current must be retarded.

An electric lamp can be seen for miles in a clear atmosphere, but it cannot pierce a London fog for any great distance. Is not the velocity of the electric current reduced in this and similar cases, owing to the obstruction of the filament, or of matter in the earth's atmosphere?

And so, in the case of a flash of lightning from cloud to earth; the air being a bad conductor of electricity may retard its velocity more or less according to the dryness and quantity of floating matter in the air. If the atmosphere offered no obstruction to the friction or impulses which cause light, there would be no light; otherwise, would not the ether in the depths of space always be illuminated by the light of the millions of suns in the heavens to such an extent, by its accumulation, as to turn our night into day?

Of course, if I am mistaken in supposing that there is an appreciable lapse of time between the commencement of a flash in a thunder-cloud and the end of the same flash at or near the surface of the earth, no retardation in the velocity of light may be caused in the way I have suggested.

As an enquirer I must beg your kind indulgence for thus troubling you with the expression of my thought.

G. R. GIBBS, Colonel (Retired).

CANMORE,
WESTBOURNE PARK ROAD,
BOURNEMOUTH.

THE TRISECTION OF AN ANGLE.

To the Editors of "KNOWLEDGE."

SIRS,—Mr. Bingley's method of dividing angles into three equal parts, published in the November number of "KNOWLEDGE," is, so far as I am aware, original, and gives accurate results for small angles. In attempting to find an approximately correct solution of the problem for larger angles, I have hit upon two simple constructions, to which I now venture to call attention. The first is an alternative method of trisecting small angles, which is not only simpler, but also more nearly exact, than that of Mr. Bingley; the second is a method applicable to larger angles.

METHOD I.—Let B A C be the angle to be divided. From A describe arc B C. Bisect arc B C in D, and join D A. Bisect A B in E, and A C in F. Join E D and F D. Bisect E D in G, and F D in H. Join A G and A H, and produce them to meet arc B C in J and K respectively. Then the angle B A C is divided into the three equal angles, B A J, J A K, K A C.

METHOD II.—As before, let B A C be the angle to be divided. From A describe arc B C. Bisect arc B C in D, and join D A. Bisect A B in E, and A C in F. Join E D and F D. Bisect E D in G, and F D in H. Join B D and D C. Join A G and A H, and produce them to meet chords B D and D C in N and P respectively. Bisect A D in L, and A L in M. Join M N and M P, and produce them to meet arc B C in J and K respectively. Join J A and K A. Then the angle B A C is divided into the three equal angles, B A J, J A K, K A C.

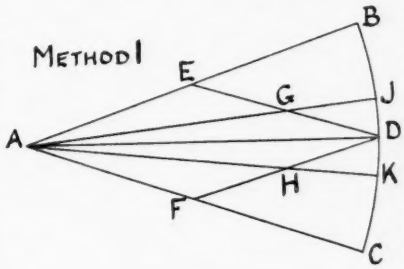


FIGURE 63.

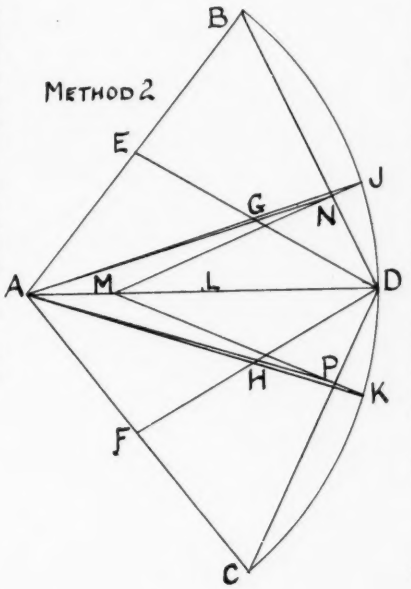


FIGURE 64.

Angle BAC (2α)	Error in Angle JAK (2β)		
	Bingley	Method I	Method II
	excess	deficit	deficit
15°	23″	11″	-
30°	3′ 4″	1′ 32″	-
45°	10′ 25″	5′ 13″	2″
90°	1° 26′ 41″	43′ 21″	1′ 0″
135°	5° 13′ 29″	2° 36′ 45″	8′ 11″
180°	13° 44′ 24″	6° 52′ 12″	39′ 0″

FIGURE 65.

It is obvious that the smaller the angle B A C, the more nearly do A J and A K coincide with A N and A P respectively, and thus approximate to the solution by Method I.

In order to ascertain the degree of accuracy of the three methods—that of Mr. Bingley and the two described above—I have examined each of them analytically. If 2α be the angle B A C, and 2β be the middle (J A K) of the three component angles, then

By the Bingley method—
$\cot \alpha + \frac{1}{2} \operatorname{cosec} \alpha = \cot \beta - \frac{1}{2} \operatorname{cosec} \beta$.
By Method I—
$\cot \alpha + 2 \operatorname{cosec} \alpha = \cot \beta$.
By Method II—
$\cot \alpha + \frac{5}{4} \operatorname{cosec} \alpha = \cot \beta - \frac{1}{4} \operatorname{cosec} \beta$.

If each of these equations be solved for different values of α, the error inherent in each method can be determined. Some of these are given in the table. It is seen that the error due to using Method I is exactly half that present in Mr. Bingley's method, and that neither of them can be used with reasonable accuracy for angles much above 45°. On the other hand, Method II is sufficiently exact for angles up to 135°, and even at 180° the error is only thirty-nine minutes. In Mr. Bingley's method the middle angle is too large, and in the other methods it is too small.

D. HALTON THOMSON.

KENLEITH, BROADLANDS ROAD,
HIGHGATE, N.

THE TRISECTION OF AN ANGLE.

To the Editors of "KNOWLEDGE."

SIRS,—In the issue of "KNOWLEDGE" for November, 1911, I noticed a problem on the trisection of an angle by a geometrical method.

As the geometrical trisection of an angle has long been supposed to be impossible, I thought at first (for I am naturally credulous) that a great discovery had been made; but when I tested the matter by a numerical example, the construction, as given by Mr. Bingley, proved to be incorrect from a mathematical point of view, although it gives a rough approximation to the truth. Suppose the angle to be divided is 22° 30′.

According to the Bingley construction, we obtain the following values for the three divisions of the angle:—

7°	31′	18″
7	27	24
7	31	18

The middle angle shows a deviation from the others of nearly four minutes, and the deviation would be still greater for a larger angle. I leave to the geometrical expert the task of pointing out the fallacy in the construction; for some fallacy there must be if the construction is supposed to be exact, and not merely an approximation.

COMPUTER.

BOSTON, MASS.

XUM

EQUATORIAL TEMPERATURE.

To the Editors of "KNOWLEDGE."

SIRS,—Whilst camped on the Mau Escarpment in this Protectorate, I received the English papers giving accounts of the great heat experienced in England, and I thought it would be of interest if I took a series of readings showing the temperatures ruling on this plateau.

The diagram attached is the result, and from it will be seen that the greatest temperature obtained during the daytime was 71° F, whilst at night it went below freezing.

The thermometer was not shaded in any way, but exposed to the full force of the sun from 6 a.m. to 6 p.m. On eleven nights out of the thirteen that I spent on the Mau, there was a heavy frost, the water in the wash-basin being covered with ice about a quarter of an inch thick. The ground temperature ranged from 30° to 130° F during the hours of 6 a.m. to 6 p.m. Of course, the Mau Escarpment is one of the coldest (inhabited) parts of British East Africa, and in most of the settled districts in the Highlands, higher temperatures are obtained, but nothing to what one would expect, situated on the Equator as we are.

BRITISH EAST AFRICA. D. G. CROFTS.

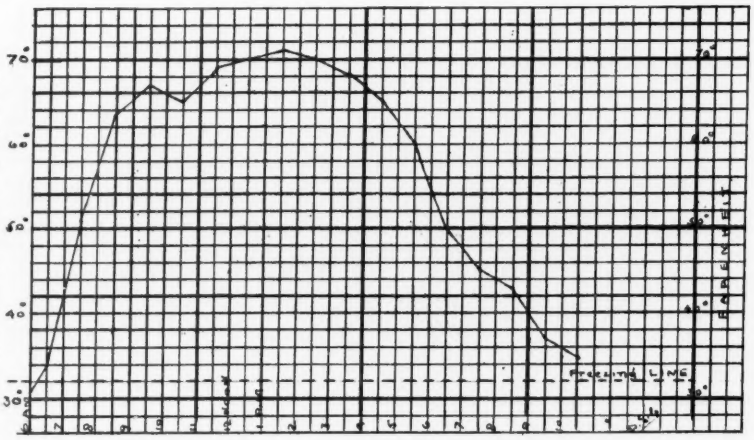


FIGURE 66.

Diagram showing Range of Temperature (in open) on Mau Escarpment on October 15th, 1911. Latitude about 0° 45′ S. Height about 9500′ above sea level.

A DURHAM BARROW.

To the Editors of "KNOWLEDGE."

SIRS,—I enclose a photograph (see Figure 67) of a Prehistoric Skeleton and Flint Knife, found in a secondary deposit in the S.E. edge of a round barrow on Batter Law, near Hawthorn, Co. Durham, on June 16th last. Batter Law is a hill forming part of an elevated tract of glacial debris known as Hesledon Moor, and rests on the Magnesian Limestone. The barrow occupies the highest point of the hill and has a diameter of about thirty-five feet, and height of about four-and-a-half-feet, but has been much disturbed by ploughing and other operations and consequently obscured; it is made of stones and earth. It is not mentioned by Canon Greenwell in "British Barrows."

Permission to explore was kindly granted by the proprietor of the ground, Mr. J. S. G. Pemberton, J.P., of Hawthorn Towers; and I started by opening up the S.E. side of the mound anticipating the possible occurrence of a secondary deposit on the S. or E. side. Almost immediately we encountered a large mass of sandstone set up on edge, and adjoining this a large oblong whinstone boulder; on clearing away the earth from these a third block was encountered which proved to be a slab of sandstone fallen down and covering the feet of the skeleton, the bones of which were found crushed and scattered beneath it. The large whinstone mass proved to be lying across the skeleton where it had probably been thrown when the rough cist was disturbed by ploughing. The skeleton proved to be that of a large and powerful apparently middle-aged man, laid on its right side, facing South, head to the West, the back of the head nearly touching the western slab of the cist, the knees drawn up and the right arm bent round and resting on the left side of the body.

The bones of that side of the body in contact with the ground had been largely removed by solution, but those of the left side were better preserved. The skull was somewhat crushed and the facial bones mostly destroyed, but the dentition was intact and well preserved, except the two upper front incisors which seem to have been lost during lifetime. The skull is now undergoing reconstruction and examination in Canon Greenwell's hands.

FIGURE 67.

Approximately in front of the knees of the skeleton was found a very beautifully-chipped knife of reddish mottled flint, quite sharp and unweathered. It is very skilfully flaked over the entire upper surface, while the under-side shows the original surface of the flake, which is untouched except for some slight secondary chipping at the base and towards the point for the purpose of removing some slight excrescences.

It is a good example of a class of implement which have been several times recorded from barrows, but not hitherto, to my knowledge, from this county. It measures three-and-five-eighths-inches in length, by one-and-one-eighth-inches in breadth.

The occurrence of a cist burial as a secondary deposit is unusual; but, perhaps, two upright slabs of sandstone with a large mass of whinstone, whose position is uncertain, can scarcely be truly called a cist; and may have been merely intended to protect and confine the body. The cist lay as nearly as possibly east and west.

C. T. TRECHMANN, B.Sc.

A KNOWLEDGE OF NAVAL PICTURES AND PRINTS.

By A. M. BROADLEY.

(Author of "Napoleon-in-Caricature," etc.)

THERE is no more popular or interesting form of collecting than that which includes within its sphere

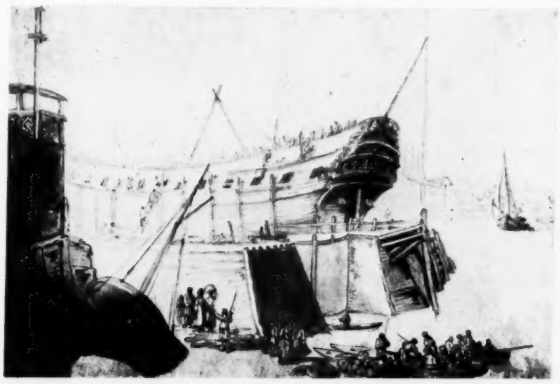


FIGURE 68.

of operations the *rariora* of the Navy, ranging as they do from medals and autograph letters to pictures, engraved prints, portraits and caricatures, valentines, songs and jest books. That an impetus will be given to the collection of naval views of every description by the opportune appearance of Mr. Harry Parker's "Naval Battles" there can be little doubt. Ever since the end of the eighteenth century three generations of the same family have distinguished themselves in the foremost rank of London print-dealers, and now the present head of the firm has brought all his expert knowledge and personal experience to bear on the production of a very delightful volume which is not only an exhaustive descriptive catalogue of the superb series of engravings formed by Commander Sir Leopold Cust, but affords the humblest collector a useful and intelligible *vade mecum*. To endeavour to collect naval prints without the aid of such a guide as Mr. Parker has now provided would be sheer folly. If anything could enhance the good work done by Mr. Parker, it would be the admirable introduction supplied by Commander C. N. Robinson, the author of "The British Fleet," whose books may be found on almost every ship of the British, American and German navies. It is assuredly in the eternal fitness of things that the namesake and godson of one of the best known and most daring of the Admirals of the Crimean War times should, at the commencement of the twentieth century, have made many important contributions alike to the history and the iconography of the Service he loves so well.

FIGURE 69.

Commander Robinson points out that the picking up of naval prints need not of necessity be a monopoly of the millionaire. The intelligent collector will, at the onset, limit his endeavours to one particular channel, and if he does this he will be astonished at the success he achieves in all sorts of out-of-the-way and unexpected places. The writer has seen a large album filled with naval "Valentines," many of which throw a curious light on the inner life of Jack Tar during the great wars of the eighteenth century. The same may be said of "chaunties" (a practically inexhaustible subject, for Jack has always loved music almost as much as tobacco or grog) and caricatures. One cannot help hoping that in the near future Commander Robinson will deal at length with the last-named subject, which has for some years engrossed his attention. A whole chapter might be devoted to the British caricatures of Nelson, many of which are very interesting as sidelights of naval history. Napoleon, for some reason or another, never incited his official caricaturists to lampoon Nelson as they did Pitt. The only French caricature of Nelson the writer has ever met with

FIGURE 70.

XUM

represents a corpulent officer with a grotesque head, wearing a huge cocked hat and standing up in a tiny boat, which is being rowed by a diminutive sailor. Under his arm is a huge official portfolio, and beside him a letter addressed to Lady Hamilton. Napoleon evidently knew the weak point in his adversary's armour. Sir Charles Cust has himself specialized in the way Commander Robinson indicates. We are told that:—

> He has gathered together every engraving which in any way illustrates his own particular subject—British battles by sea. The collector who acts on these lines, and selects a definite subject possessing a personal attraction and connection, has one great advantage over the more orthodox connoisseur of prints; for he does not want to worry about "states" or "margins," or other points which require special knowledge, if not a thorough technical education. The intrinsic value of the print for him will rest in its subject, and although he may desire and appreciate technical beauty if he can get it, it will be less an object than human and historical interest. The pleasure of picking up—perhaps as a bargain—yet another example, and adding it to one's gallery or cabinet, can only be adequately realised by the ardent collector.

Sir Charles Cust has succeeded in obtaining no less than seven hundred aquatints, engravings and lithographs relating to British naval achievements at sea. He begins with Julius Cæsar's invasion of Britain in 55 B.C., and ends with the operations at the entrance of the Pei-Ho River on June 25th, 1859. For Sir Charles Cust the piquant satirical print has apparently no charm, nor is any mention made of the numerous glass-pictures which for long years decorated the mariner's cottage and kept green the memory of Nelson, the Dorset Hoods and Sir Thomas Hardy. At least twenty of these quaint illustrations relate to the tragedy of Trafalgar. A few of them possess a certain amount of artistic merit. To those who reside on or near the English littoral this book will prove exceptionally interesting. Many of the keenly-contested engagements which have been fought within sight of our shores are almost forgotten. Most Dorset men, for instance, are aware of the discomfiture of the Spanish Armada off Portland Bill in the eventful summer of 1588, but some seventy years later a scarcely less important action took place in the same waters. The second "Battle of Portland" took place in February, 1653, and lasted three days. The best known of the English admirals engaged were Blake, Monck, Peacock, Martin and Penn, and in the end they gained a signal triumph over Tromp and de Ruyter:—

> About twenty English ships were first to engage the enemy, and were nearly annihilated by the overwhelming number of the Dutch, but as soon as the remainder of the fleet arrived the Dutch endeavoured to make their escape, and on the 19th arrived off the Isle of Wight. Blake (who had previously won an abundant crop of laurels on land at Bridgwater, Taunton and Lyme Regis) then re-engaged with great desperation, and after a most valiant fight drove the enemy before him and captured or destroyed eleven ships of war and sixty merchantmen. One thousand five hundred men were killed and seven hundred taken prisoners.

Sir Charles Cust has discovered no less than four illustrations of this comparatively little-known engagement—one of English origin (dated 1803), and three Dutch. M. Küsell published an etching of the battle as early as March 24th, 1653. Curiously enough, the name of that gifted artist, Thomas Rowlandson, does not appear in Mr. Parker's carefully prepared index. This is probably explained by the fact that Rowlandson's naval pictures were not, strictly speaking, descriptive of actual engagements, although the reproductions of the two original drawings in the present writer's collection obviously relate to naval warfare. As far as the writer is aware, engravings from these admirable water-colours do not exist. They may be supplemented very effectively by the spirited and striking sketch by "W. H." which shows the "Victory" as she appeared just fifty years after Nelson's death and the date of Rowlandson's drawings.

THE ROYAL ANTHROPOLOGICAL INSTITUTE.

MR. ALFRED P. MAUDSLAY, F.S.A., F.R.G.S., delivered his Presidential Address at the Annual General Meeting of the Royal Anthropological Institute, on Tuesday, January 23rd. Mr. Maudslay said that even at the present day the idea that the origin of man does not form a fit subject for scientific enquiry has not yet entirely died out, and this feeling has militated against anthropology becoming a popular study. Meanwhile the immediate and energetic prosecution of anthropological studies is of vital necessity, since the material with which this science deals is becoming rarer every year, as primitive customs yield to civilization. The fact that man's physique is less subject to alteration gives a permanent value to the study of physical anthropology.

Mr. Maudslay confined the bulk of his remarks to certain points in the archaeology of America, where there are traces of many extinct civilisations. He incidentally pointed out that many misunderstandings between European and barbarous races might be avoided by a knowledge of elementary anthropology, and mentioned that the Institute had never ceased to press upon the Government the advisability of establishing in this country an anthropological bureau, which would be of material assistance to colonial administration.

The address terminated with an appeal to all fellows of the Institute to do their utmost to make a success of the International Congress of Americanists in London, which will be held during May, 1912, saying that though we possess in England more pre-Columbian objects of interest than are preserved in any other European country, it is the first time that we have acted as hosts to the leaders of American research.

XUM

REVIEWS.

BIOLOGY.

Life in the Sea. — By JAMES JOHNSTONE, B.Sc., Fisheries Laboratory, University of Liverpool. 150 pages. Numerous illustrations. $6\frac{3}{4}$-in. × $4\frac{3}{4}$-in.

(Cambridge University Press. Price 1/- net.)

This is a fascinating introduction to a study of the economy of the sea, a department of marine biology which has made great strides within recent years, partly through the quantitative plankton investigations which estimate the productivity of a sea-area and partly through the correlation of the minute life of the sea with currents and other physical conditions. Mr. Johnstone has been actively engaged in marine biological investigations for many years past, and he tells his tale with vigour and clearness. He starts off with an imaginary walk along the sea bottom to North America, which introduces the reader to a variety of zones and faunal areas. His second chapter is devoted to rhythmical changes in the sea,—"the tides, the annual waves of temperature, salinity and sunlight; annual outbursts of animal and vegetable life; animal and plant migrations; spawning periods; fishery seasons and the like." In an admirable analysis of the factors of distribution —the subject of Chapter III—Mr. Johnstone discusses many interesting facts, such as that the polar and temperate seas are, generally speaking, far richer in life than are tropical seas, and the lengthening out of life at low temperatures. To our thinking the author speaks the words of wisdom when he notes in regard to migrations that it seems to be rather straining after generality to describe all these as tropisms, and that the behaviour of an animal at any time is modified by its past experience which is registered within it. In the fourth and fifth chapters the different modes of nutrition and the sources of food are discussed, and attention is paid to the recent theory or heresy that many marine animals feed "saprozoically"—by the absorption of dissolved organic matter in the sea, on the stock of the sea-soup as it were. The amount of carbon compounds (other than carbonates) and of nitrogen compounds (other than ammonia or nitrates) dissolved in sea water is small, but it is greater than the amount of proteid or carbohydrate contained in similar volumes of water in the form of plankton. We cannot do more than indicate the general trend of this delightful and stimulating volume, which we would recommend with the greatest cordiality. It should not be missed by any one interested in the science of the sea.

J. ARTHUR THOMSON.

CHEMISTRY.

Some Chemical Problems of To-day.—By R. K. DUNCAN. 54 pages. 34 illustrations. $8\frac{1}{2}$-in. × $5\frac{1}{2}$-in.

(Harper & Bros. Price 2 dollars net.)

Professor Duncan is an enthusiast in the matter of technical chemistry, and his book is a veritable mine of suggestion upon the practical applications of the science. In every industry there are chemical problems in pressing need of solution, and here we have an outline of many of these difficulties, which will tax all the resources of the trained chemist to meet.

And is not, so the author urges, an education which tends to the solution of such industrial problems as good an intellectual training as that usually given? His attitude upon this question may be summarised in his own words: "The many and important actual opportunities that lie everywhere at hand for applying scientific knowledge and the scientific method to the manufacturing needs of men make one frankly consider why trained and earnest men should devote laborious days to making diketotetrahydroquinazoline, or some equally academic substance, while on every side these men are needed for the accomplishment of real achievement in a world of manufacturing waste and ignorance."

But, although America has greater facilities for meeting this need than we possess in this country, yet we find Professor Duncan lamenting that "the present state of American manufactures is one of inefficiency." The picture he draws of the position of the research chemist in American works is not a pleasant one to contemplate. He has no security of tenure, and in most cases works under unsuitable conditions, and while his retaining his poorly-paid position depends upon speedy returns for his work in cash, he is rarely given any pecuniary interest in his discoveries, which become the property of his employers. This is the impression left by this part of the book, and the outlook for the future does not appear very hopeful.

But it is not only in the direction of applied chemistry that the reader will find much to interest him in this brightly written and stimulating book, for there are also excellent chapters on "The Question of the Atom," "The Chemical Interpretation of Life," and "The Beginning of Things," in which is given a clear outline of Chamberlin's planetismal hypothesis, illustrated by a series of beautiful photographs of spiral nebulae, which were taken at the Lick Observatory. The book is so well worth reading in every part that we can forgive the use of words and expressions that grate upon English ears. But why should the author go out of his way to talk about the "young chemist seeking an *arbeit*" or "The trained *chemiker*," when we have English words to convey the same ideas?

C. A. M.

Chemical Phenomena in Life.—By FREDERICK CZAPEK, M.D., Ph.D. (Harper's Library of Living Thought). 152 pages. 7-in. × $4\frac{1}{2}$-in.

(Harper and Bros. Price 2/6 net, cloth; 3/6 net, leather.)

In this welcome addition to a well-known series of short monographs Professor Czapek gives a concise, yet readable, account of the present state of our knowledge of the chemical processes involved in what is commonly understood by "life."

The book deals more especially with the biological chemistry of plants, and only incidentally with the allied phenomena of animal life. After a short historical survey of the connection between biology and chemistry, chapters are devoted to protoplasm, colloidal chemistry, the chemical action of living matter, enzymes, and chemical adaptation and inheritance.

Owing to the necessity for severe compression within a small space the subject lacks sufficient elaboration in places, while, on the other hand, it occasionally goes into more detail than is suitable for a book intended for the general reader rather than the specialist.

The author does not attempt to evolve a chemical definition of life, although he lays stress upon many facts tending towards such a definition. Thus, on page 19 he writes, "The final result of our discussion is that there are many reasons for maintaining that protoplasm really is of a peculiar chemical constitution, and that it does not merely represent a mechanical structure."

In this connection it may be mentioned that in several places an attempt is made to draw too sharp a distinction between living and inorganic matter, as, for example, on page 10, where it is stated that the chemist studying inorganic matter "will be accustomed to see that no change takes place in the matter under investigation unless an experiment be made."

This ignores the continual changes which recent researches have proved to be taking place in radio-active and (not improbably) other bodies, with the degradation of one form of inorganic matter into another—changes which in the more rapid cases we can follow, but cannot influence by any experimental means at our disposal.

C. A. M.

XUM

A Handbook of Organic Analysis.—By H. THACHER CLARKE, B.Sc. (Lond.), A.I.C. 264 pages. 23 illustrations. 7½-in. × 5-in.

(Edwin Arnold. Price 5/- net.)

This small book should meet the long-felt want of a concise text book upon organic qualitative analysis. It deals systematically with the identification of different organic radicles, and organic compounds, and gives a new and most useful classified table of the physical properties of the more common substances. This table will obviate the necessity of frequent references to chemical dictionaries or larger text books; in future editions it might with advantage be amplified so as to include some of the important compounds omitted. The section of these tables dealing with the identification of different classes of dyestuffs will prove particularly valuable.

The latter half of the book, which deals with the quantitative analysis and determination of the physical properties of organic compounds, does not present the same novel features as the first part, though it describes clearly, and at sufficient length, the different methods of estimation. Even processes not ordinarily found in elementary handbooks, such as, for example, Wijs' method of determining the halogen absorption of unsaturated bodies, are here fully described.

The book is well printed, and illustrated with diagrams where necessary, and we can thoroughly recommend it as a laboratory companion both to the student and advanced worker in organic chemistry.

C. A. M.

CRYSTALLOGRAPHY.

Crystallography and Practical Crystal Measurement.—By A. E. H. TUTTON, D.Sc., M.A. (Oxon), F.R.S., A.R.C. Sc., Vice-President of the Mineralogical Society. 946 pages. 720 figures in the text and 3 plates. 9-in. × 6-in.

(Macmillan & Co. Price 30/- net.)

The subject of crystallography being one which claims so few ardent students in this country, it is perhaps not to be wondered at that English authors and publishers have for some years refrained from any large and exhaustive publication on the subject. The fine work which has now been published will be heartily welcomed by all crystallographers and will undoubtedly rank as a standard work on the subject.

As its title implies, the book is intended as a guide to the practical measurement of crystals rather than as a complete text-book of crystallography. The author has made every effort to remove all grounds for the assertion, so frequently made, that crystallography can only be studied by mathematicians. Accordingly, while pointing out the real need of a knowledge of higher mathematics for the thorough mastering of crystallography, the author has reduced the computation of the physical constants of crystals to the application of some four pages of simple formulae, all geometrical or analytical proofs of these formulae being omitted.

The first part of the book is devoted to the morphological characters of crystals. A few pages on the nature of crystals serve as an introduction to accurate instructions for the growing and selection of crystals suitable for measurement. The simplest types of goniometers are then described in great detail, and in the fourth chapter the knowledge already obtained is shown to be sufficient to enable the reader to measure completely a crystal of potassium sulphate. After devoting three chapters to the conceptions of crystal axes, face indices and zones, and to the stereographic projection, and the few simple formulae mentioned above, the results of the measurements made in Chapter IV are worked out. The simplification of the mathematics has, perhaps, been carried a little too far and strikes one as being somewhat inconsistent. Thus, while elaborate pains are taken to explain the application of Napier's rules, the reader is left in entire ignorance of the signification of the "zone indices," which are obtained by cross-multiplying the indices of any two faces in the zone. The reader who has little knowledge of mathematics may at first fail to appreciate Chapter IX, which is a truly brilliant *resumé* of the mathematical work on crystal-structure, and will no doubt appeal more to advanced students.

The seven crystal-systems are next studied, commencing with the cubic system, as being the one requiring the simplest calculations, and leading gradually up to the more difficult systems. Two chapters are devoted to each system, one dealing with the elements of symmetry and possible forms in the various classes, the other giving examples of crystals measured by the author, each one completely worked out, the results being tabulated in the form adopted in publications of crystallographic data.

The methods employed for drawing crystals are clearly set forth in Chapter XXV, again with the aid of as little mathematics as possible, but calling attention to Penfield's excellent methods based on the stereographic projection. Twinning and planes of cleavage and gliding are dismissed in two short chapters, and the first part of the book concludes with a description of recent advances in goniometry, the determination of density, and a clear account of the theories of crystal-structure put forward by Fedorov and by Pope and Barlow, this last chapter being a most valuable contribution.

The second part deals mainly with the optical properties of crystals and no pains have been spared to make this part thorough. The chapter reviewing recent ideas on the nature of light and the three succeeding chapters pave the way for the study of the transmission of light through uniaxial and biaxial crystals. The determinations of optical constants are described in the same detailed manner as the measurements in the first part. Two chapters on the crystallographic microscope are full of useful suggestions and descriptions of the most recent methods. The remaining three chapters are occupied with thermal expansion, elasticity and hardness, with a brief summary of the recent work on liquid crystals.

Throughout the book the treatment is better suited to chemical crystallography than to mineralogy. A sufficient supply of material of the highest degree of purity and of perfect crystal development is postulated, and the mineralogist may frequently find himself unable to attain the degree of accuracy which the author has shown to be possible with crystals grown under suitable conditions. This book, however, sets before all crystallographers an ideal at which to aim, and it is to be hoped that its influence in this direction will be widely felt.

The fact which adds enormously to the value of the book is that every branch of the subject which is treated at length is one to our knowledge of which the author himself has contributed very largely. Consequently, we have in this book the results of years of experience in carrying out most accurate and laborious measurements. The care and accurate detail with which the book has been written yield most eloquent testimony to the untiring patience and accuracy which characterise all Dr. Tutton's work.

The figures with which the book is lavishly illustrated are most beautifully reproduced, and the publishers, as well as the author, are to be heartily congratulated and thanked for so valuable a publication.

W. C. S.

MEDICINE.

The Art of Life—The Way to Health and longevity.—By J. L. CHUNDRA, L.M.S. 240 pages. Illustrated. 7½-in. × 5-in.

(Calcutta University. Price 3/- net.)

This interesting little book is unique in many ways. The author is clearly a man of very wide reading, and gives us the combined wisdom of the East and West. Thus we find quotations from the Hindu Scriptures and from the latest American medical journals on the same page, and while ordinary medical prescriptions are given, we are also told that "Persons who have been given up to die are often restored to perfect health in a few minutes by the hands of the Magnetic Healer." The author has written his book for the laity and medical profession alike, but the inclusion among its "varied and valued ingredients" of detailed medical prescriptions and full descriptions of indolaceturia, cretinuria, and so on, would

seem to our Western minds a little undesirable if the laity are really expected to read it. Moreover, the English is in places a little obscure. Among some excellent rules for the care of infants we read: "Don't forget to put the child in the sun or sunshade for two hours at least a day."

Nevertheless, the book contains much sound, practical, useful advice, particularly applicable to those resident in warm countries, and every page shows us that the author, if a little over-credulous, has considered most carefully the problems of existence, and knows how to express his meaning clearly, tersely and in a very interesting style.

Further Researches into Induced Cell-reproduction and Cancer. By H. C. ROSS. The McFadden Researches. 63 pages. 5 plates. 9-in.×5¾-in.

(John Murray. Price 3/6 net.)

The present volume contains a series of papers by Messrs. H. C. and E. H. Ross and J. W. Cropper, on certain changes which they have observed in red and white blood corpuscles, when these are supported on a film of jelly and various chemical substances are made to act upon them. The researches here described are a continuation of those recorded in a volume published a year previously, a review of which appeared in "KNOWLEDGE" for March, 1911, and many of the observations therein made apply with equal force to the present edition. There can be no doubt as to the care and accuracy of the observations recorded, and of the value of the methods which the authors have introduced. Whether in all particulars they are correct in the interpretation of their results is a question upon which pathologists are still divided. No one will, however, doubt that both volumes form a valuable contribution to the physiology and pathology of the blood.

MINERALOGY.

The World's Minerals.—By LEONARD J. SPENCER, M.A., F.G.S. 212 pages. 61 illustrations. 8½-in. × 5½-in.

(W. & R. Chambers. Price 5/-.)

The author of this book is an official of the Mineral Department of the British Museum and is the editor of the *Mineralogical Magazine*.

In 1904 he translated from German, into English, the beautiful work upon precious stones by Dr. Max Bauer of the University of Marburg, and also made certain additions to the text. We believe that the English edition of this work is now out of print.

In the preface to "The World's Minerals" the author tells us that the book deals with one hundred and sixteen of the more simple minerals, which are illustrated by one hundred and sixty-three figures in the coloured plates, and that mention also is made of the various applications of minerals, their importance as ores of metals as precious stones, and so on.

We are sure that the information given of the various minerals is in every way correct, especially considering the position which the author has so long occupied and the work which he has previously done. We find, however, that in some cases the descriptions are so meagre as to be somewhat misleading.

As an example of what we refer to we may quote Spinel, which is described as a red mineral occurring in the cubic system, which when cut as a gem somewhat resembles the ruby in appearance, but the author does not tell us that it also, in different specimens, is green, blue, brown and violet.

We also cannot quite understand why such a mineral as chrysoberyl, with its important gem-stone varieties, has been omitted.

On page 90 the author describes the fibrous variety of quartz as catseye, and refers the reader to an illustration stated to be made from a specimen from Ceylon. Now, the beautiful catseyes of Ceylon are a variety of the mineral chrysoberyl, and they rank among the most important precious stones, while the chatoyant quartz is a stone of quite minor consideration, commercially, and in every other respect, although it slightly resembles the chrysoberyl catseye in general appearance. The writer does not explain this, nor is it apparent that he is aware of the fact.

The book will probably be welcome, for it is written in such a clear manner that every student will be easily able to understand it.

The coloured plates are very numerous and add considerably to the value of the work. They have been prepared under the supervision of Dr. Hans Lenk, Professor of Mineralogy and Geology in the University of Erlangen, and many of the pictures represent actual specimens belonging to the collection under his charge.

Here and there we take exception to a shade of colour, but this is probably due to the process of reproduction.

In the early pages of the book the author gives an introduction to the study of minerals which will be most helpful to the student.

Chapter 2 is devoted to "The Forms of Minerals," and we notice here that crystals are classified under seven systems and not six as is customary, and we rather wish the author had given us his reason for doing so.

The book has an excellent index, which appears to be reliable.

PHYSICS.

Physical and Chemical Constants and some Mathematical Functions.—By G. W. C. KAYE and T. H. LABY. 153 pages. 9¾-in.×6¾-in.

(Longmans, Green & Co. Price 4/6 net.)

The authors have compiled a most useful book of reference. It is remarkable how much is to be found in this thin book of one hundred and fifty pages. One can find within all the data which one is constantly requiring to look up during one's work in the laboratory, except, of course, the less common constants, which one could hardly expect to find even in Landolt Börnstein and Meyerhoffer's "Physikalisch-Chemische Tabellen." For instance, one would find the boiling point of pentane but for the melting point, which is somewhere below − 200° C., one would have to search in some original paper.

The book is very concentrated, and as a reference book is therefore, all the more useful. It commences with the units, and passes on to astronomical data, then follows a very complete set of data in the subjects of heat, sound, and light. The section on radioactivity and gaseous ionisation is excellent and gathers much valuable work together in a set of excellent tables. The Chemistry section is necessarily rather curtailed, but the chief properties of all the commoner chemical substances are to be found in two tables of the physical constants of inorganic and organic substances. There is a short table of solubilities in water of a few common substances, but a complete solubility table requires a large book of its own.

The mathematical tables at the end, though only occupying eighteen pages, are those that are most generally needed and are very conveniently arranged. A table of the exponential e^{-x} will be very useful to students of radioactivity.

As far as one can judge, the tables are reliable and thoroughly up-to-date, while the recently-formed international committee for the yearly publication of physical and chemical constants will help to make it the easier to keep the book abreast of the times.

The value of the book is enhanced by brief references to books and original papers which have bearing on the various subjects under consideration.

The book is excellently got up and thoroughly suitable for the laboratory.

ZOÖLOGY.

Primitive Animals.—By GEOFFREY SMITH, M.A., Fellow of New College, Oxford. 156 pages. 25 figures. 6¾-in.×4¾-in.

(Cambridge University Press. Price 1/- net.)

It was a happy idea on the author's part to give this introduction to the study of phylogeny a concrete and picturesque basis in a series of "primitive animals" or old-fashioned types, like Peripatus and Platypus, Anaspides and Amphioxus. "Relics of a distant past, the features of which have been all

but effaced by the passage of time, they preserve for us a record of bygone phases of existence, and often point us to some of the sources from which the modern world of living things has arisen." Phylogeny, or racial history, seems to be a red rag to many zoölogists to-day, because of considerable recklessness in pedigree-making in the early days of Darwinian enthusiasm, but it seems a pity to react to the extent of leaving the doctrine of descent as a sort of abstract formula of an evolution-process, which has no doubt occurred, but of which the less we say the better, since all is so uncertain. Mr. Geoffrey Smith is not one of the extreme sceptics as to the possibility of phylogenetic conclusions, for though he does not think that we can speculate to good purpose in regard to the inter-relationships of phyla, he believes that within the limits of the great groups "comparative morphology has supplied us with a number of securely founded generalizations of real value." To students who wish to turn from the abstract discussion of "factors of evolution" to the concrete problems of affiliation —and there should be many of this mood—this little book will be a welcome guide. It is very fresh and interesting, its scientific temper is in itself educative, it is full of what we venture to call morphological suggestiveness. The first chapter gives an outline of the great series or phyla of animals; the second discusses beginnings—among Protozoa and Protophyta; the third treats of the great Appendiculate phylum (which seems to us very top-heavy); the fourth is a wise discussion of the relation between individual development (ontogeny) and racial evolution (phylogeny); the fifth deals with the ancestry of the vertebrates, the sixth with the possession of the dry land, and the seventh with the rise of mammals. The last chapter of reflections, which stretches the title of the book to the breaking-point, may be regarded, we hope, as the bud of another book as good as this one.

J. ARTHUR THOMSON.

The Natural History and Antiquities of Selborne in the County of Southampton.—By GILBERT WHITE. With illustrations in colour by George Edward Collins, R.B.A. 476 pages. 7½-in. × 10-in.

(Macmillan & Company. Price 10s. 6d. net.)

There are still a number of people who are interested in Natural History who have yet to experience the pleasure and delight of reading Gilbert White's masterpiece. To them we recommend the new quarto edition of the Natural History of Selborne which Messrs. Macmillan & Company have recently published. It is a faithful reprint of the work of "The Naturalist's Calendar, with observations in various branches of natural history," which Dr. John Aikin extracted from the "Naturalist's Journal" kept by Gilbert White from the year 1768, to the time of his death in 1793. This journal and the Garden Calendar, which he kept previously, and began in the year 1751, are now in the British Museum. There are many of those who know "The Natural History of Selborne" who will welcome the opportunity of renewing their acquaintance with it by means of the readable edition under review, which has wide margins and is illustrated by a number of sketches by George Edward Collins, reproduced by the three-colour process. The effect which the work of Gilbert White has had on the study of Nature in this country is very great; for his observations had great influence on many prominent naturalists, including Charles Darwin, and it is most fascinating to read how the country curate differentiated between the Willow Warbler, Chiffchaff, and the Wood Warbler; how he recorded for the first time the occurrence of the minute Harvest Mouse and its ball-like nest; or how, again, he sought for evidence in favour of the old theory, now long exploded, that swallows hibernate in winter.

THE ASSOCIATION OF PUBLIC SCHOOL SCIENCE MASTERS

THE Twelfth Annual Meeting of the Association of Public School Science Masters was held at the London Day Training College, on January 10th and 11th. The President this year was Sir J. J. Thomson, F.R.S. He urged the necessity of a proper use of text books, and pointed out that although the students who come up to learn Physics at the Cavendish Laboratory were no longer deficient in mathematical knowledge and the classes specially held for their benefit in this subject were being discontinued, there was a very small proportion who could translate a passage from German into English. Considerable discussion was raised by Mr. Matthew Davenport Hill's paper on "The Value of Chemistry and Physics as an Introduction to Biology." School Biology meaning Morphology, Mr. Hill did not think a training in more exact science should necessarily precede it, and we remember Mr. Ashford, when he was at Harrow some years ago, urging in an educational conference that Natural History was the best introduction to science for young children, for they all had some amount of interest in living things, whereas Physics and Chemistry were quite new to them. The great advantage of teaching Plant Biology in a school was instanced by Mr. E. I. Lewis, of Oundle. Mr. C. E. Ashford, of The Royal Naval College, Dartmouth, discussed the place of Electrostatics in a science course, while papers were read on the teaching of Qualitative Analysis and on Educational Pschology, the latter by Mr. A. Vassall, of Harrow.

As usual there was an exhibition of scientific apparatus and books. Messrs. Philip Harris & Co., of Birmingham, showed a full series of Galvanometers, Theodolites and so on as well as a novelty in the shape of a cheap stop-clock, working models of a chemical laboratory bench; verniers and spherometers were exhibited by Messrs. Baird & Tatlock; while on the stand of Messrs. F. E. Becker & Company was a novelty in the shape of a compact set of wireless telegraphic apparatus which will work over a distance of two miles. Another noteworthy exhibit by this firm was a liquefaction apparatus which will liquify sulphur dioxide or ammonia.

Messrs. Brown & Sons staged a number of stills of various patterns, in addition to examples of their well-known apparatus for physical work. Messrs. Cussons had on view a new arrangement for finding the force of gravity designed by Mr. Mott, of Giggleswick, and consists of a free-falling plate with an electrical release. The model of this, we believe, was exhibited last year amongst the apparatus designed and shown by members of the Public School Science Masters' Association themselves. We may mention also that Messrs. A. Gallenkamp & Co. are well-known as balance-makers and their physics apparatus is also worthy of mention. Messrs. Reynolds & Bransome, of Leeds, showed a number of new accessories used with Stroud and Rendell's science lantern for demonstrating the laws of optics, and the "Rystos" optical bench for attachment to the same lantern.

Among the novelties which might be picked out from the large series contributed by Messrs. Townson & Mercer we may speak of Blackman's improved rapid filter, which depends for its success on the fact that the cone of the filter paper does not come into contact with the glass of the funnel. Allusion may also be made to their vacuum filters.

Microscopes and accessories were shown by Messrs. W. Watson & Sons, and for the description of a new microscope demonstration table we refer our readers to our Microscopical Column.

An opportunity was afforded to those who visited the exhibition of seeing the latest books on science brought out by the Oxford and Cambridge and Tutorial Presses as well as by Mr. Edward Arnold, Messrs. George Bell, Messrs. Macmillan and Messrs. Methuen.

In the members' section was shown a modified form of Fletcher's apparatus by Mr. D. P. Berridge, of Malvern. By a judicious introduction of metal, the wear and tear which is a drawback to the wooden form has been avoided as well as the great weight which results when the apparatus is made entirely of iron. Messrs. Cussons, who are putting this apparatus on the market also showed an example of it. An ingenious way of making model volcanoes was demonstrated by Mr. G. H. Martin, of Bradford.

NOTES.

ASTRONOMY.

By A. C. D. CROMMELIN, B.A., D.Sc., F.R.A.S.

METEORS.—An important paper on meteors has been published by Charles P. Olivier in the *Transactions of the American Philosophical Society*. He has discussed the observations of six thousand five hundred meteors seen between 1898 and 1910, and deduced one hundred and seventy-five parabolic orbits; a great many were observed by himself at the Lick Observatory. He makes an absolute rule that radiants must only be determined by combining observations made on the same night, and says that neglect of this rule has led to the deduction of many fictitious radiants. Most of the meteors were seen in July, August, October, November; several in January, April, May, a few in December. There were no observations in February, March, June, September.

The first shower discussed is the Aquarids, of which good observations were obtained on 1910, May $5^d \cdot 0$, $6^d \cdot 9$, $12^d \cdot 0$ G.M.T. The radiants at the three dates were: (1) $334° \cdot 0 - 3° \cdot 4$, (2) $337° \cdot 7 - 0° \cdot 6$, (3) $342° \cdot 0 - 0° \cdot 6$. The parabolic orbits, and the orbit of Halley's comet, are given below, also the orbit of the Orionids (4).

	ω	Ω	ι	q
(1)	111°·0	44°·1	166°·2	·677
(2)	102 ·3	46 ·0	163 ·2	·607
(3)	104 ·3	50 ·8	166 ·7	·630
(E	111 ·7	57 ·3	163 ·2	·587
(4)	87 ·8	25 ·6	161 ·4	·536

The connection of the meteors with the comet is considered established, but they have spread out greatly from the comet's orbit. In fact, a cylinder of radius thirteen million miles appears to be filled with them. It seems not impossible that the Orionid Stream may also have a connection with the comet, meeting the Earth near the other node of the orbit. The connection, however, is far more doubtful than in the case of the Aquarids. The Perseids and the October streams are fully discussed, the latter being shown to consist of a main stream and a number of minor ones, with radiants separated by several degrees. It is suggested that these minor streams had the same origin as the great stream, but have been gradually separated from it. He does not accept the stationary position of the Orionid radiant, but finds evidence of an eastward motion. He doubts the reality of stationary radiants in other cases also, and follows Bredichin in the view that they are composite. Of the one hundred and seventy-five orbits only twenty-seven are direct, but this arises from the greater chance of our meeting a meteor moving in the reverse direction to the Earth, just as more trams pass a pedestrian in the opposite direction to his motion. Twenty-eight perihelia lie in the first quadrant of longitude, sixty-six in the second, sixteen in the third, fifty-five in the fourth.

He notes as evidence of the clearness of the atmosphere at Mt. Hamilton that most of the meteors seen there are of the fourth magnitude, while in Virginia those of the third magnitude predominated. Yellow meteors have the shortest time of visibility, red and orange longer, green and white longest.

GROUPS OF STARS WITH COMMON DRIFT.—Several groups of stars that seem to be travelling in company have now been recognised. The best known is the Ursa Major group, to which Sirius was recently added. There is a group in Taurus, and one in Perseus. Mr. Benjamin Boss (*Astron. Journ.* No. 629) makes a notable addition to the list, having detected a group of stars with large proper motions, which appear to be moving with equal velocities on nearly parallel lines. The following is the list of stars. Their convergent point is R.A. $6^h\ 37^m$, N. Dec. $0° \cdot 5$. The observed and computed position angles of the motion of each are given; it will be seen how closely they agree. μ is the Proper Motion in a century.

Star.	For 1875. R.A.	For 1875. Dec.	μ	Pos. Angle. Obs.	Pos. Angle. Comp.
	h. m.				
Pi. O, 130	0 31	S 25°·4	139″	90°	90°
Pi, I, 142	1 34	N 42 ·0	82	100	99
δ Triang.	2 9	N 33 ·7	118	102	103
Greenw., 1860, 284	3 55	N 35 ·0	221	128	124
λ Aurig.	5 10	N 40 ·0	84	141	147
π Mensae	5 47	S 80 ·6	109	11	13
Pi. VII. 321 ...	8 4	N 32 ·8	81	215	217
Lal. 4887	11 41	S 39 ·8	157	284	279
61^1 Cygni	21 1	N 38 ·1	525	52	49
61^2 Cygni	21 1	N 38 ·1	515	54	49
ϵ Indi	21 54	S 57 ·3	470	124	126
ν Indi	22 14	S 72 ·9	145	119	124

To test the matter further, Mr. Boss examined the radial motions, as far as these are available. The linear velocity of the group relatively to the Sun is ninety-five kilometres per second. With the exception of the second star (which possibly does not belong to the group) the results are surprisingly harmonious, and leave no doubt of the reality of the common drift.

The computed and observed parallaxes are also compared. In several cases there is good accordance; in the case of the smaller parallaxes the observed values are uncertain. The stars are in the same order as in the first list.

No.	Radial Vel. Obs.	Radial Vel. Comp.	Parallax. Obs.	Parallax. Comp.
	km.	km.		
1	—	− 2	(″·36)	·07
2	+ 5	+18	·12	·04
3	—	+32	·12	·06
4	—	+60	(·01)	·14
5	+66	+70	·11	·06
6	+12	+14	—	·06
7	—	+75	·05	·06
8	+18	+17	—	·08
9	−62	−60	·31	·34
10	—	−60	·31	·34
11	−39	−34	·28	·25
12	—	−18	—	·07

I have already alluded to Mr. Eddington's paper on "Star distribution" at the British Association. One interesting point that he brings out is that the actual frequency of stars of different spectral types may be very different from their frequency in our catalogues. Thus, in his list of the seventeen newest stars three are of the type denoted by Ma, while in our catalogues only one star in fifteen is of this type.

The Orion or Helium type (denoted by β) is commoner in the catalogue than Ma, but none appear among our nearest neighbours. He gives as the explanation that Ma stars are really pretty common everywhere, but, being intrinsically very faint, cannot be seen at great distances; while the Helium stars are very rare, but being of extreme brilliance are visible at immense distances. This is confirmed by the failure to detect sensible parallax in such stars.

XUM

Astr. Nachrichten 4543 contains an interesting note by E. Hertzsprung, on the star Groomb. 34 (R.A. 0^h 13^m, N. Dec. 43°·5). This is one of the seventeen nearest stars, its parallax being 0″·28, proper motion 2″·86, magnitude 7·7; it has an eleventh-magnitude companion, whose position angle in 1864 was 53°, distance 39″·8; in 1908 these had changed to 57°, 38″·7. The note suggests that this companion is the least luminous star known to us, being 8·3 magnitudes less than our sun at the same distance. If of the same surface brightness as our sun it would be comparable with Jupiter in size. The principal star is of a yellow colour and Ma spectrum; the companion agrees in colour, and doubtless in spectrum. It will be long before enough of the orbit has been described to determine the masses of the two stars. These may differ much less than the luminosities, as in the cases of Sirius and Procyon.

SCHAUMASSE'S COMET.—The following ephemeris of this comet is from later elements, and therefore more accurate than the one given in the "Face of the Sky." It is for Paris midnight:—

	R.A. H. M. S.	S.Dec.		R.A. H. M. S.	S.Dec.
Feb. 6	16 15 28	3° 51′	Feb. 22	16 40 13	4° 22′
„ 10	16 22 23	4 2	„ 26	16 45 8	4 25
„ 14	16 28 50	4 11	Mar. 1	16 49 30	4 27
„ 18	16 34 46	4 17	„ 5	16 53 18	4 27

ERRATUM LAST MONTH.—In the table of errors of Encke's Comet, insert the word "*minus*" between "Observed" and "Computed."

BOTANY.

By PROFESSOR F. CAVERS, D.Sc., F.L.S.

MUTATION IN SHEPHERD'S PURSE.—From time to time more or less strikingly abnormal forms have been described in the widespread and very variable Shepherd's Purse. For instance, in 1886 (*Bot. Centralblatt*, Band 26, page 121), Wille pointed out that various earlier observers had described abnormal forms of such Crucifers as Wallflower and Charlock, which had more than the usual number (two) of carpels, the number in some cases being as great as six, but more often four. In some Crucifers there are normally four carpels, and a four-valved fruit, *e.g. Holargidium* and *Tetrapoma*. Wille had seen, in 1883, a single Shepherd's Purse plant with three abnormal fruits which had three, four, and six wings respectively. The three-winged capsule had three valves, one complete and one incomplete partition, and six rows of seeds; that with four wings had four valves, two complete partitions, and eight rows of seeds; while that with six wings consisted of an ordinary two-valved fruit fused with a four-valved one, the stigmas being separate.

In 1900 (*Bot. Zeitung*, Band 58), Solms-Laubach described a form which may be regarded as having arisen by mutation from the common Shepherd's Purse (*Capsella bursa-pastoris*). This new species (*Capsella heegeri*) had appeared suddenly and spontaneously, and on being cultivated for several years retained its characters, that is, bred true from seed—it is an annual plant, like ordinary Shepherd's Purse. Excepting for the structure of its fruit, *C. heegeri* resembles a variety of *C. bursa-pastoris* with the radical leaves pinnately cut. The capsule, however, is egg-shaped, showing neither the flattening nor the two humps characteristic of *C. bursa-pastoris*, and has at its base a short thick stalk. Solms regards this new species as having arisen by mutation from *Capsella bursa-pastoris*, since its characters are constant and the fruit is widely different—sufficiently so, in fact, to justify its being placed in a new genus.

Shull (*Proc. Int. Zoöl. Congress, Boston*, 1907; published in 1910—abstract in *Bot. Centralblatt, Band 116*, 1911) isolated four types or elementary species of *Capsella bursa-pastoris* differing in leaf characters, and found that in crossing they behave as a Mendelian hybrid. Reciprocal crosses were then made between *C. heegeri* and the simplest of the four elementary species of *C. bursa-pastoris*. In this way four elementary species of *C. heegeri* were produced, the leaf characters of these hybrids showing Mendelian ratios, but the *heegeri* capsules appearing only in about one plant in two hundred and twenty-three of the second generation (see Figure 2).

Blaringhem (*Bull. Sci. France et Belg.*, 1911) has recently described another new form of *Capsella*, a single specimen of which was found growing among abundant *C. bursa-pastoris*. This history of this new species (*C. viguieri*) parallels that of *C. heegeri*, but *C. viguieri* shows a variation of the capsules in the opposite direction from that presented by *C. heegeri*. The great majority of the capsules have four valves, resembling the two valves of *C. bursa-pastoris* and placed at right angles to each other, but the number of valves varies from two to eight. Counts of nearly ten thousand fruits showed:—Two-valved, 2; three-valved, 81; four-valved, 8450; five-valved, 301; six-valved, 288; seven-valved, 24; eight-valved, 16. This new species is normally fasciated, and breeds true to this character as well as to the high number of valves. The leaves are almost entirely unlobed.

Solms, Blaringhem, and Wille (whose paper appears to have been overlooked by later writers on the subject, but has been consulted by the present reviewer) lay stress on the fact that several species of Cruciferae have four-winged capsules. It is quite obvious that several species of *Tetrapoma* would, if two-valved, be classified as species of *Nasturtium*; the genus *Holargidium*, if two-valved, would be merged in *Draba*; while the Californian genus *Tropidocarpon* has one species with two valves and one species with four. Moreover, four-carpelled varieties, both cultivated and wild, are known in such genera as *Cheiranthus, Brassica, Isatis*, and other Crucifers. Such instances as these, of the recurrence of similar characters in more or less closely related species or genera, support the view that variation is definite, or "orthogenetic," rather than entirely fortuitous.

In reviewing Blaringhem's paper, Shull (*Bot. Gaz.*, June, 1911) remarks that mutations probably occur in Nature as frequently, in proportion to the percentage of the seeds which succeed in germinating and developing, as in experimental cultures, but actual proof of such mutation is necessarily wanting, as a rule. When a single individual of a hitherto unknown type is seen to differ by some marked characteristic from the associated typical individuals of the most closely related species, the natural inference is that the non-typical plant is a mutant. Such evidence is strengthened if the plant is found to reproduce its characteristics in its offspring, but there remains the question of possible hybridisation; and if even that be satisfactorily ruled out, there is the possibility that the form in question is not itself a mutant, but the offspring of a mutant, which appeared in some preceding generation. This last question cannot, of course, be cleared up in any case, but it is of no essential importance.

BROWN FLAGELLATES AND BROWN ALGAE.—Pascher has recently published two interesting papers (*Ber. d. deutsch. bot. Ges.*, 1911) dealing with Brown Flagellates and the relations of these to the Brown Algae.

In the first paper he gives a short account of two new genera of Brown Flagellates. *Cryptochrysis*, which was only observed in the motile state, resembles other Flagellata in having no cell-wall and in dividing by a plane parallel to the long axis of the body, which is an ellipsoid mass of protoplasm; the broader notched anterior end bears two whip-like flagella, and the protoplast contains two brown pigment-bodies. *Protochrysis* is also ellipsoid but curved and bean-shaped, with two flagella inserted at the middle of the concave side; the chromatophores, two in number, may be reddish or bluish-green instead of brown; division occurs in a motionless condition, the cells rounding off, becoming surrounded by a swollen membrane and dividing into colonies of from four to eight cells.

XUM

The Flagellates included by Pascher under the family Cryptomonadinae are rather few, the most interesting (in addition to the two new genera just mentioned) being *Zoöxanthella* which lives in symbiosis with lowly animals like the Radiolaria. The Cryptomonads are distinguished from the other Flagellates, especially the Chrysomonads, by the remarkably dorsiventral or one-sided (as opposed to radial) symmetry of the body, which is obliquely truncated at the anterior end; the presence of a curious furrow, which is usually in the longitudinal plane but in *Protochrysis* is equatorial; the frequently red or blue tinge of the usually brown chromatophores; the unequal pair of cilia inserted in the furrow.

Starting from the simple Chrysomonads, these probably gave rise to the Cryptomonads, and the red and blue varieties of the latter then became fixed characters in the red genus *Rhodomonas*, which may be regarded as the direct Flagellate ancestor of the Red Algae, and in the blue-green genera *Chroömonas* and *Cyanomonas*, which may have given rise to the Blue-green Algae. A third line arising from the Cryptomonad group (*e.g.*, *Cryptochrysis* and *Protochrysis*) passed through Cryptomonas, in which the apical furrow gradually becomes deeper and forms an "oesophagus" (a cavity which extends more or less deeply into the protoplast, and into which the contractile vacuole opens); this line of larger and more highly organised forms ends blindly in heterotrophic (saprophytic) genera like *Chilomonas* and *Cyathomonas*.

The most important line arising from the Cryptomonads, however, is that leading through the remarkable series of Phaeocapsaceae to the higher Brown Algae. The Phaeocapsaceae correspond, in the Brown Series, to the Tetrasporaceae in the Green Series leading from Green Flagellates to Green Algae. In the Phaeocapsaceae we get a series of forms passing almost insensibly from true Flagellates to true though simple Brown Algae. The first known member in this series is *Phaeoplax marina* (formerly called *Phaeococcus marinus*). In *Phaeoplax*, the motile reproductive cells exactly resemble *Cryptochrysis*, having the same dorsiventral symmetry and the same minute structure, but the plant passes the greater part of its existence in the motionless condition, dividing to form a mass of cells enveloped by mucilage derived from the cellulose walls (the Cryptomonads themselves have no cellulose walls). Through forms showing increasing suppression of the motile phase, and increasing elaboration of the cell-masses formed by division in the resting stage, we come to the genus *Phaeothamnion*, which forms branch filaments and produces sexual reproductive bodies (gametes)—sexual reproduction does not occur in the Cryptomonads or any other Flagellates so far as known.

Pascher's paper is an interesting contribution to the evolution of the Algae from Flagellates. The phylogeny of the Green Algae has been worked out in great detail—see Blackman's well-known paper (*Annals of Botany*, 1900)—but less is known concerning the relation of Brown Flagellates to Brown Algae, and still less regarding the Red and Blue-green Flagellates and Algae. Still, there seems to be little ground for doubting that the Brown, Red, and Blue-green Algae have arisen from some such Flagellate group as the Cryptomonads.

CLASSIFICATION OF BRYOPHYTA.—At the end of a series of papers on "The Inter-relationships of the Bryophyta" in the *New Phytologist*, the present writer has proposed a new classification of this group of plants. The old-established primary division of the Bryophytes into Mosses and Liverworts is called in question, especially in connexion with the small families Anthocerotaceae and Sphagnaceae (Peat Mosses), and it is interesting to note that in certain of the characters which have been regarded as excluding the Anthoceros family from Liverworts on one hand, and the Sphagna from the Mosses on the other, these two aberrant groups show a striking resemblance to each other. After discussing the advisability of dividing the Bryophytes into four classes—true Liverworts, Anthocerotes, Sphagna, and true Mosses—the writer proceeds to elaborate a new classification. It is proposed to divide the Bryophytes into ten independent groups, as follows:—

I.—Sphaerocarpales, including Sphaerocarpaceae (*Sphaerocarpus* and *Geothallus*) and Riellaceae (*Riella*).

II.—Marchantiales, including Ricciaceae, Corsiniaceae, Targioniaceae, Monocleaceae, Cleveaceae, Aytoniaceae, and Marchantiaceae.

III.—Jungermanniales, including the Anacrogynous families Aneuraceae, Blyttiaceae, Codoniaceae; the transitional family Calobryaceae; and the Acrogynous families Lophoziaceae, Cephaloziaceae, Ptilidiaceae, Scapaniaceae, Radulaceae, Pleuroziaceae, Porellaceae, and Lejeuneaceae.

IV.—Anthocerotales, including Anthocerotaceae.

V.—Sphagnales, including Sphagnaceae (*Sphagnum*).

VI.—Andreaeales, including Andreaeaceae (*Andreaea*).

VII.—Tetraphidales, including Tetraphidaceae.

VIII.—Polytrichales, including Polytrichaceae and Dawsoniaceae.

IX.—Buxbaumiales, including Buxbaumiaceae and Diphysciaceae.

X.—Eu-Bryales, including all the higher mosses.

All these groups are characterised and their relationships discussed. The arrangement of the lower Bryophytes is based largely on the writer's own work, while for the higher mosses (Eu-Bryales) the writer accepts the views of Lorch, Philibert, and Fleischer, with some modifications.

The classification of the higher mosses can no longer be based upon such characters as the position of the fruit (the old groups Acrocarpi and Pleurocarpi) nor upon the presence or absence of a peristome (Stegocarpi and Cleistocarpi of previous authors), though the various terms—acrocarpous, pleurocarpous, stegocarpous, cleistocarpous—may be retained for purely descriptive purposes. In the new classification of mosses proposed by the writer, the Eu-Bryales are divided first into *Haplolepideae*, *Heterolepideae*, and *Diplolepideae*, according to the single or double character of the peristome, and the various cleistocarpous forms are simply distributed through these groups according to what appear to be their affinities as either reduced or primitive types allied to different peristome-bearing families. The further division of the great group Diplolepideae is based upon minute, but readily observable, differences in the structure of the peristome.

Throughout this series of papers, it is assumed as a working theory that the Bryophyta form an ascending series, marked by progressive elaboration of the sporophyte; that the sporogonium of the Bryophyta has arisen as an interpolated generation, with increasing "sterilisation of potentially sporogenous tissue," from the segmented oöspore; that although the archaic condition in which the sporogonium was a simple spore-fruit consisting of a mass of sporogenous cells, is not actually realised in any known Bryophyte, we have in the *Riccia* capsule a primitive sporophyte in which sterilisation has proceeded only as far as the formation of a single peripheral cell-layer forming the capsule-wall; and that the *Riccia* type of sporogonium is not only the simplest but also the most primitive known.

This theory has been much disputed, but at any rate the question is apparently still an open one. The writer's object in this series of papers has not been so much to discuss the position of the Bryophyta as a whole and its relations to other divisions of the Vegetable Kingdom, as to give a summary of the various families of Mosses and Liverworts and of their relations one to the other.

The "Inter-Relationships of the Bryophyta" is obtainable separately, as a "*New Phytologist* Reprint," from the Editor of the *New Phytologist*, Botany School, Cambridge University (price 4/-, postage 4d.); it contains numerous illustrations and full lists of the literature of Mosses and Liverworts.

XUM

CHEMISTRY.

By C. AINSWORTH MITCHELL, B.A. (OXON.), F.I.C.

PRODUCTION OF SOLID OXYGEN.—Sir James Dewar has at length succeeded in solidifying oxygen by evaporation of the liquid, as has been done in the case of hydrogen and nitrogen, and he gives an account of his experiments in the *Proc. Royal Soc.* (1911, A LXXXV, 589). The pure liquid oxygen was placed in an isolated vessel, and the pressure lowered at about the temperature of the boiling liquid until the element solidified to a transparent jelly. The melting-point of solid oxygen, which was determined by means of a hydrogen thermometer, was found to be 54° (absol.).

ALCOHOL FROM WOOD WASTE IN SWEDEN.—Although it is many years since the conditions for producing alcohol from sawdust were ascertained, most of the factories established for the purpose have met with but little commercial success. Recently, however, the economic problem has been attacked from another side in Sweden, and an interesting account of the new industry is given by Mr. T. H. Norton, in a Consular report to the United States Government.

In the preparation of cellulose from wood the waste sulphite lyes contain about fifty per cent. of the wood originally introduced into the boilers; and since about ten tons of residual lye are left for each ton of cellulose made by the process, the profitable utilisation of this waste material has long been an industrial difficulty. These waste lyes contain various sugars, including dextrose (glucose), together with acetic acid, nitrogenous compounds, tannins, and the calcium lignin-sulphonate, which is the main product formed in the reaction.

The sugars, most of which are fermentable, constitute about one per cent. of the lyes, and it is from them that the alcohol is produced. The liquid is first neutralised by the addition of calcium carbonate and then fermented in the usual way by the addition of yeast. The resulting spirit is separated by distillation and concentrated by redistillation as in the ordinary process of manufacture, and about six gallons of one hundred per cent. alcohol are thus obtained from each one thousand gallons of lye, or about fourteen gallons for each ton of cellulose.

This crude alcohol, which contains methyl alcohol and other impurities, is used for various technical purposes, such as heating, varnish making, and so on, and the Swedish excise duties have been modified in its favour. If alcohol were manufactured in this way from all the sulphite works in Sweden, there would be an annual output of three million five hundred thousand gallons, but Mr. Norton doubts whether Sweden could utilise this quantity of the crude product. About eight hundred thousand gallons of alcohol could be made in the same way from the waste lyes of the sulphite works in Germany, provided that the economic conditions were suitable; but this, in the opinion of German chemists, is open to question.

In the direct preparation of alcohol from wood the finely divided material is treated with dilute sulphuric acid under pressure, so as to cause partial hydrolysis of the cellulose, with the formation of dextrose. The liquid is filtered, neutralised, and fermented with yeast, and the alcohol separated by distillation. Mr. Norton states that about fifteen per cent. of alcohol may be obtained from pure cellulose, and from five to six per cent. from ordinary wood.

THE COMPOSITION OF SOOT.—The chemistry of soot is dealt with in a paper read before the Society of Chemical Industry, by Professor Cohen and Mr. A. G. Ruston (*J. Soc. Chem. Ind.*, 1911, XXX, 1360) and their results afford much valuable information to the agriculturist. Soot consists chiefly of carbon, tar, and mineral matter, with smaller proportions of sulphur and nitrogenous compounds, and frequently has an acid reaction. The proportion of the various constituents varies greatly with different factors, such as the nature of the coal, the completeness of combustion and the distance from the fire at which the soot was deposited.

Compared with ordinary domestic soot the product from factory boilers is poor in carbon and volatile products, such as tar and ammonium salts, and contains much ash, and the nearer the base of the boiler chimney, the more pronounced is this difference, since the high temperature prevents recondensation of the volatile products. This is illustrated by the percentage results of various analyses, of which the following are typical:—

	Carbon.	Hydrogen.	Nitrogen.	Ash.	Tar.	Sulphur.	Chlorine.	Acidity.
Coal	69·30	4·80	1·39	8·48	1·64	1·74	0·27	0·00
Domestic Soot ..	40·50	4·37	4·09	18·16	25·91	2·09	5·19	0·37
Boiler Soot, at base ..	16·66	0·86	0·00	75·04	0·09	2·07	0·11	1·33
Boiler Soot, 70-ft. up	21·80	1·44	1·18	66·04	0·80	2·58	1·46	0·58
Boiler Soot, at top, 110-ft. up ..	27·00	1·68	1·21	61·80	1·66	2·84	1·60	0·56

Speaking generally, the proportions of nitrogen, sulphur and chlorine in boiler soot increase with the height of the deposit in the chimney, whereas in the case of domestic soot there is a decrease in these constituents. The value of soot as a fertiliser depends partly upon its physical action in causing a greater absorption (by reason of its dark colour) of the sun's rays, and thus raising the temperature of the soil. It also helps to lighten heavy soils, while the presence of the sulphur accounts for its action in preventing the approach of slugs.

Its manurial value depends upon the small proportion of ammonia or ammonium salts which it has absorbed from the volatile gases in the chimney. Taking the value of nitrogen in fertilisers as about twelve shillings per unit, or sixpence per lb., the value of domestic soot may vary from about 24s. to £5 per ton, since the nitrogen in such soot ranges from about two to eight per cent. The usual price paid for soot is £2 to £3, so that the customer may or may not be purchasing cheaply.

Although it is not possible to determine the proportion of nitrogen by any simple method, it has been found that the more springy and bulky the soot, the greater the proportion of nitrogen, and consequently the manurial value. A good domestic soot ought not to weigh more than twenty-eight lbs. to the bushel, and it is recommended that the purchaser should stipulate that the consignment shall contain at least four bushels per hundredweight.

With regard to the loss of coal carbon as soot, experiments made by various chemists have shown that this amounts to at least six per cent. of the weight of the coal in domestic fires, and to about five per cent. in factory furnaces. On this basis, the annual minimum loss of coal in the form of soot in the United Kingdom is estimated to be two million four hundred and twenty thousand tons.

The proportion of soot deposited over a given area may be estimated by determining the solid impurities deposited after a fall of snow, and by a determination of the solid matter carried down by the rain. Experiments made in both ways have shown that the average deposit of soot over the whole of Leeds corresponds to at least two hundred and twenty tons per square mile in a year.

GEOLOGY.

By G. W. TYRRELL, A.R.C.Sc., F.G.S.

ORIGIN OF RADIOLARIAN CHERT.—Many radiolarian cherts have hitherto been regarded as of deep-sea origin. Their exceeding fineness of grain, freedom from terrigenous material, and the abundance of their characteristic organisms has led to their identification as fossil representatives of sediments similar to the radiolarian oozes of the present ocean depths. Many observers, however, have pointed out that radiolarian cherts are frequently associated with shallow-water deposits. Their freedom from any but the very finest terrigenous material has militated against the view that the cherts themselves are of shallow-water origin. Mr. E. E. L. Dixon, in discussing the radiolarian cherts of the Carboniferous Limestone of Gower, Glamorganshire (*Q.J.G.S.*,

November, 1911), gets over this difficulty by concluding that their deposition took place, along with other fine-grained deposits, in still and semi-isolated lagoon waters. Four lagoon or *Modiola*-phases are recognised in the Avonian of Gower. By a lagoon-phase is meant a series of rocks whose characters show that they have been deposited in coastal areas of wide extent, but so extremely shallow as to have become effectively isolated from the neighbouring deeper parts of the sea, and thus the sites of peculiar types of sediment and fauna. Three of these lagoon-phases are calcareous, and besides typical shallow-water deposits such as oolites, ostracod-beds, and beds containing fragments of contemporaneous sediments, they contain peculiar rocks consisting mainly of very fine-grained homogeneous limestones ("chinastone-limestones"), landscape marbles, and calcite-bearing mudstones. These rocks are all distinguished by a uniform fineness of grain, which suggests that their deposition was an exceedingly slow and gentle process. The fourth and uppermost lagoon-phase in Gower, consists of radiolarian cherts interbedded with laminated shales containing a few shallow-water lamellibranchs and plant fragments. From this association is inferred a shallow-water origin for the cherts, which view is supported by several lithological features. The cherts are banded or laminated, the laminae differing in the proportion and nature of their detrital material. Many of the laminae are decidedly lenticular or wedge-bedded. This points to the play of gentle currents laden with various fine sediments. It is also shown that radiolaria are not exclusively deep-sea organisms, but are found at all depths. Moreover, lagoon-conditions would be favourable to their development, provided that the salinity of the water was not greater than that of ordinary sea-water, a condition that would be supplied by the proximity of a river.

PILLOW LAVAS IN THE DALRADIAN SCHISTS.—Pillow lavas associated with the Loch Awe group of the Dalradian Schists are described in a recently-issued Memoir of the Geological Survey (Sheet 28, Knapdale). These occur in the Tayvallich peninsula of the Knapdale district of Argyllshire. Their successful study has depended on the low grade of metamorphism in the Tayvallich peninsula. The degree of metamorphism of the schists gradually decreases in a direction across the strike from south-east to north-west, and also along the strike from north-east to south-west. The minimum of metamorphism is attained in the Knapdale district, where the rocks are little more than cleaved. The quartzites of the Loch Awe group are now considered to pass under the limestone and slate division, whereas, beforehand, on the evidence of certain conglomerate bands, the reverse was supposed to be the case. The evidence for this change of opinion has been obtained mainly from the study of the associated pillow-lavas. In several places the latter form pillow-shaped masses exactly similar to those developed at Ballantrae (Ayrshire), Cornwall, and other British localities. They are slaggy, vesicular, and intercalated with thin beds of ash, black slate and limestone. The striking contrast between the tops and bottoms of the lowermost flows has provided the clue to the true stratigraphical succession in the district. The second lava of the type-section in the bay to the south of Port-an-Sgadain gives most conclusive evidence that the whole series is "right side up." The base of this flow conforms exactly to the bedding of an underlying thin seam of dolomite, and is characterised by large steam-tubes ("pipe-amygdaloids") an inch in diameter, and reaching one foot in length. These are set at right angles to the base of the lava, and were probably caused by the uprise of steam from the moist sediment below. The interior of the flow contains parallel bands of spherical vesicles, and it is overlaid by a thin dolomite which fills up all irregularities, and does not appear "baked." As the lavas are interbedded with limestone, and underlaid by black slate and quartzite, the inference is that the order named is the true descending order of succession. Similarly, the Loch Awe group is underlaid, in the same descending succession, by the Ardrishaig Phyllites, still "right-way-up." The Tayvallich pillow-lavas thus provide a most striking clue to the true succession in the complicated district of the south-western highlands.

METEOROLOGY.

By JOHN A. CURTIS, F.R.MET.SOC.

THE weather of the week ended December 23rd, as set out in the Weekly Weather Report issued by the Meteorological Office, was mild and wet, with thunderstorms in Scotland on the 17th, and in Ireland on the 17th and 18th.

Temperature was much above the average in all Districts, the excess reaching 6°·9 in England, E. The highest maximum was 58° at Hawarden Bridge, but 57° was reported at places as far apart as Glencarron, Dublin and Jersey. The lowest of the minima was 25° at Balmoral. At many stations, however, no frost was observed, and in the English Channel the temperature did not fall below 43° during the week. The lowest reading on the grass was 20° at Crathes and Newton Rigg.

Rainfall was also in excess in all Districts, and was very greatly so in many cases. Thus, in England, S.E., the total was more than four times, and in the Midlands more than three times the usual amount. At most of the stations rain was measured on each day of the week. There were, however, no exceptionally heavy falls, the greatest amount reported on one day being 1·07 inches, at Plymouth on the 20th, and at Crieff on the 23rd.

In spite of the rainfall the sunshine was in excess in Scotland, N. and E., and in Ireland, N. In the other districts, however, it was normal, or in defect. The highest aggregates were 14·1 hours (31%) at Nairn, and 14·7 hours (29%) at Birr Castle. At Westminster, the total was only 0·9 hours (2%). The mean temperature of the sea water varied from 41°·7 at Kirkwall to 49°·8 at Salcombe.

The week ended December 30th was also mild and wet, with thunderstorms at Bournemouth on the 24th, and at Tunbridge Wells, Cardiff and Markree Castle on the 25th.

Temperature was above the average in all districts, the greatest excess being 6°·0 in England, S.E. Maxima exceeding 50° were reported from all the districts except Scotland N., where the highest reading was 49°. The highest of the maxima, 56°, was reported at Bawtry, Blacksod Point and Killarney. The lowest readings recorded were 26° at West Linton, and 28° at several stations. In England, E., the minimum was 32°, and in the English Channel it was 40°. On the grass, minima down to 20° (at Newton Rigg) were reported.

The rainfall was again in excess, except in Ireland, S., where it was just normal. The differences from average were, however, in no case very large. At some stations in England, N.E., the amounts were quite small, under 0·2 inch, although made up of amounts on five or six days. At Glencarron, on the other hand, the total for the week rose to 3·62 inches, or half as much again as usual.

Sunshine was deficient except in England, N.E., where it was normal. The greatest deficiency was in the Western districts, and at Dublin the total for the week was only 0·6 hours or 22% below the average. In Westminster, the total was 2·4 hours (5%).

The mean temperature of the sea-water ranged from 41°·2 at Burnmouth to 49°·8 at Salcombe.

The New Year opened with a continuance of dull, wet weather. Aurora was observed at Gordon Castle on the 5th, and a thunderstorm at Jersey on the 6th, on which day, in the Northern districts, snow and sleet were generally experienced.

Temperature was still above the average in all districts, the excess reaching 6°·3 in the Midlands and England, S.E. The maxima exceeded 50° in all parts and rose to 56° at Leith and Hawarden Bridge on the 1st. At no station was the maximum for the week reported as less than 49°. The lowest reading for the week was 27° at Poltalloch, on the 5th, but at quite a number of stations the temperature did not fall to freezing point, and at some it did not fall even to 40°.

Rainfall was in excess of the average except in Scotland, E. and W., where it was slightly below it. The excesses however were not great, in spite of the fact that at a few stations large aggregates were reported, up to 4·13 ins. at Glencarron.

XUM

Sunshine was in defect in all districts except Scotland, E., where it was normal, with a daily *mean* of 1·1 hours. The sunniest stations were Marchmont, Cockle Park and Weymouth, each with a daily average of 1·5 hours, but at several stations the sunshine record for the week was nil. At Westminster the daily average was 0·4 hours (5%).

The temperature of the sea water was very generally above the average, and the means varied from 42°·0 at Burnmouth to 50°·1 at Salcombe.

The week ended January 13th was unsettled, with much snow and sleet in the more northern parts of the country.

Temperature was lower than of late, but was still above the average of twenty-five years, except in England, N.E., where it was normal. The highest of the maxima did not exceed 54°, which was reported at a number of stations in different parts of the country, including stations as far north as Strathpeffer.

Frost was experienced in all districts except the English Channel. In Scotland, E., minima of 14° were reported at West Linton, and 13° at Balmoral. On the grass, readings still lower were observed, down to 10° at Balmoral, 12° at Buxton and 15° at Glasgow, and Newton Rigg.

Rainfall was below the average in Scotland, N., England, S.E., and the English Channel, but was above it elsewhere. In Ireland the total for the week was more than double the usual amount. There was heavy snow in Scotland on Monday; at Crieff it was 10 inches deep, and at Crathes when melted it yielded 1·78 inches of rain.

Sunshine was deficient in the Eastern districts, but was in excess in most of the Western districts. The daily average for the district varied from 0·8 hours (10%) in the Midlands and England, S.E., to 1·8 hours (23%) in Ireland, S. Dublin was the sunniest station, with a daily average of 2·1 hours (28%). At Westminster the average was 0·6 hours (8%).

The temperature of the sea water was above the average at most places. The mean values varied from 40°·2 at Scarborough to 49°·0 at Scilly.

MICROSCOPY.

conducted with the assistance of the following microscopists :—

ARTHUR C. BANFIELD. ARTHUR EARLAND, F.R.M.S.
THE REV. E. W. BOWELL. RICHARD T. LEWIS, F.R.M.S.
JAMES BURTON. CHAS F. ROUSSELET, F.R.M.S
CHARLES H. CAFFYN. D. J. SCOURFIELD, F.R.M.S.
C. D. SOAR, F.L.S., F.R.M.S.

THE SELBORNE SOCIETY'S CONVERSAZIONE.—The number of microscopes shown at the Annual Conversaziones of the Selborne Society is larger, perhaps, than at any other meeting now-a-days in London. The next display will be on February 16th, in the offices of the Civil Service Commission, Burlington Gardens, New Bond Street, W., and any microscopists who would like to exhibit are requested to communicate with the Secretary of the Selborne Society, at 42, Bloomsbury Square, W.C.

SOOTY FUNGUS ON LEAVES AND ORANGES.—It must often have been noticed that towards autumn the upper sides of the leaves of many trees and shrubs become covered with a soot-like deposit. No doubt this is usually looked upon as merely dirt and dust which has collected on them during the summer. The commoner qualities of oranges frequently show the same thing, it being particularly evident near the place to which the flower was attached. Of course there is some dirt present in each case, but the appearance is generally largely due to a fungus growing upon the surface. If the leaf is allowed to dry slightly, the coating may be detached in flakes by carefully inserting the point of a knife under it. Some of the thinnest pieces should be soaked in spirit and water, to which a little glycerine may be added after some hours. On examination under the microscope it will be found that the object has the appearance represented in Figure 71, A. It is the mycelium of a fungus not parasitic on the leaf, but obtaining its nourishment from honeydew secreted by the green flies (aphides) so plentiful in some seasons, and which falls on the upper surface of the leaves of the lower branches. There is very little information on the subject accessible to the ordinary microscopist, but the fungus is mentioned and a figure given in Dr. M. C. Cooke's "Fungoid Pests of Cultivated Plants," as *Fumago vagans* (Pers). He says:—"This black mould is familiar enough, as it occurs on the foliage of numerous trees in this country, and especially such as are subject to honeydew. It forms black patches on the leaves to such an extent as to form a crust; but in this condition it is simply an imperfect fungus, and may develop into a species of *Capnodium* or *Meliola*, as the case may be." The specimens occurring on the orange may be treated in the same manner as the others, and it is usually easy to obtain flakes sufficiently large and thin for convenient examination if the fruit is somewhat shrivelled. Such a flake is represented in Figure 71, B. It will be noticed that the mycelium differs from that of the *Fumago*, being less moniliform and more filamentous in character, though there is much variety in various examples of both. In some cases a more advanced stage is present and perithecia may be found in considerable numbers. (Figure 71, C.) These are erect bodies, slightly thicker in the middle, almost like narrow tall bottles sometimes branched, composed of threads of mycelium arranged side by side frequently with a spiral twist which is only evident under a high power. At the top the threads are separated and form a fringe round the mouth (fimbriated), while others spring from the sides and base forming a kind of undergrowth, among which the perithecia are situated. These filaments are much more thread-like than those composing the body of the plant, the cells are longer, lighter in colour, with the divisions between them far less distinct. Dr. Cooke says "genuine *sporidia* have never been found" but "minute sporules or conidia have been met with." These latter are plentiful near the specimens represented at Figure C, but are too small to be visible under the same magnification. The fungus also occurs on the leaves of orange and lemon trees in Europe, the United States, and Australia, frequently in sufficient amount to cause much damage. When present on the upper surface it must prevent the proper action of light on the chlorophyll, and when on both sides, as it is sometimes in the mango (*Mangifera indica*), it clogs the stomata and checks transpiration in addition. There is considerable uncertainty as to the life-history, and consequently correct classification of the varieties, but apparently when mycelium only is present and of the character represented at A, the fungus is looked upon as a *Meliola*, while when there are perithecia, with mycelium, as at B and C, some species of *Capnodium* is indicated. What is clear is, that all depend for their development upon the presence of honeydew or the excrement of aphides, scale insects, and so on, and that, though not directly parasitic, they cause much loss by hindering the vital functions of the plants on which they occur. The pretty little white four-winged "snowy fly" (*Aleyrodes*), closely related to the scale insects, which sometimes appears in vast quantities on cabbage plants as to constitute a pest, is often followed by an attack of sooty fungus. The figures are drawn from specimens mounted in glycerine jelly. That at A is from a leaf of Hedge Maple ×210; B and C are from an orange, B×210, C×40.

J. BURTON.

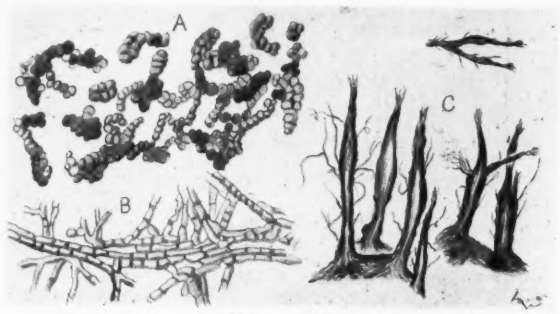


FIGURE 71.
A. Mycelium of *Fumago vagans*. B. Mycelium of *Capnodium*.
C. Perithecia of the same.

LOW POWER PHOTO-MICROGRAPHY FOR NATURALISTS. PART II.

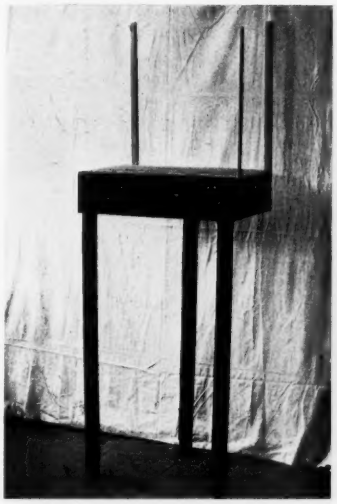


FIGURE 72.

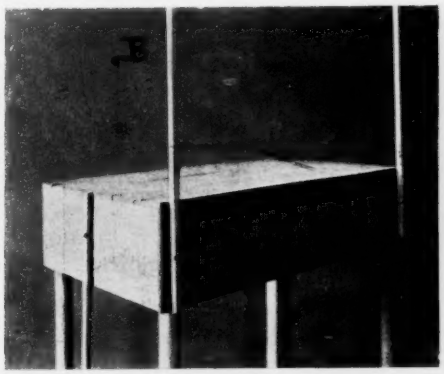


FIGURE 73.

FIGURE 74.

The naturalist is frequently interested in photographing his subjects about three or four times life-size, and wishes to secure results with the minimum exposure, so that the movement of the object may not spoil the picture. In this connection he will naturally seek the quickest plate, largest lens aperture, and most effective lighting scheme. With regard to the last-named factor, much depends on being able to place and hold the object in good bright daylight. This brings us to the imperative need of a portable stand.

Figure 72 shows us a quite practical stand, made by turning an old packing case—a Covent Garden flower box, to be precise — mouth downwards, and fixing inside each corner a broomstick, by means of long screws from the outside, to serve as legs for the table. Next we take three round (penny) blind laths and get a flat side, by a stroke or two of a jack plane, to each lath. Two of them, B and C, (Figure 73), are fixed by one screw each to the back side of the table top, the third, A, to the centre of one end.

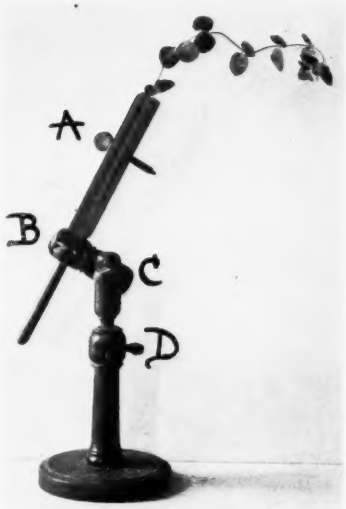


FIGURE 75.

The screw is just tight enough to enable the lath to turn on it as an axis, with the flat side of the rod against the box sides. The two laths at the back of the box are designed to support the card or paper backgrounds, while that at the end supports a white card reflector, *vide* Figure 74, where D, the background paper, is fixed by drawing pins to C and D, and E, the reflecting card (non-shiny), rests against A.

When the table is not in use it is safer to turn these three laths down, as we see A turned down in Figure 73.

For working in a room with a quite level floor one may use a four-legged stand, *e.g.*, Figure 73; but with an uneven floor or when working out doors, it will be found better to rely on a three-legged stand such as is shown in Figures 72 and 74. In this case the legs should be of two-inch by one-inch quartering or something of that kind that is considerably heavier than broomsticks The height of the table may conveniently be adjusted so that when the camera is on the tripod for use when one is

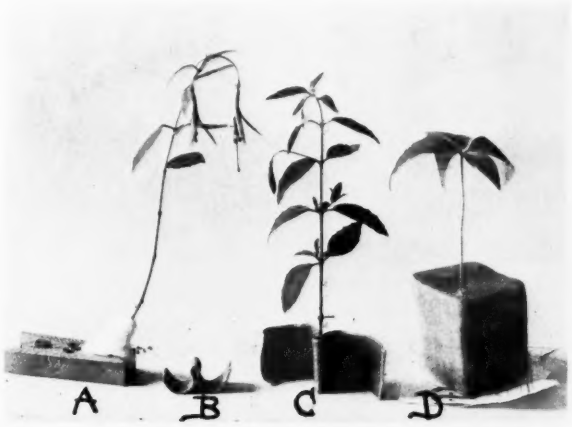


FIGURE 76.

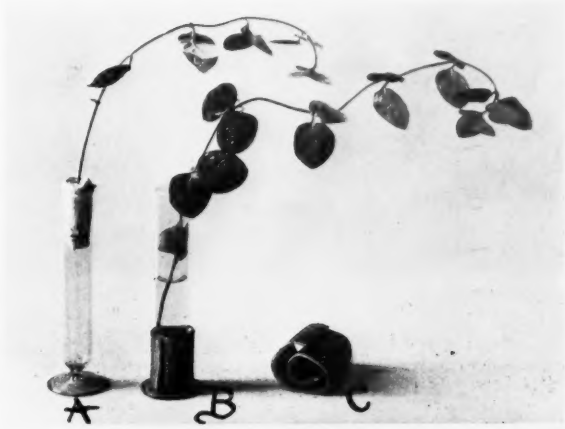


FIGURE 77.

XUM

standing at one's work the camera base board is about on a level with the table top.

For backgrounds with this stand it is convenient to fix a sheet of card to the two back supports B and C with drawing pins, and then attach a piece of coloured paper to this card by spring paper-clips of the bulldog or similar type. One requires white, light and dark grey and black backgrounds. This, like crayon paper, should not have a shiny surface.

In immediate connection with this form of portable stand is the question of holding such objects as botanical specimens where it is required to photograph, let us say, a small branch in the position or angle it grows in nature.

One of the most useful tools is the familiar "universal holder" found in every chemical laboratory (see Figure 75). The cork-lined hinged jaws of the sliding piece AB are adjusted by means of the screw at A to hold the specimen. B is another screw to hold the rounded end of AB. The joint at C is regulated by a third screw here, while D is another screw for holding a rod-like part sliding in the socket.

There are, however, many homely expedients of a simpler and cheaper character worthy of mention.

Turning to Figure 76 we have at A a branch end held in wet cotton wool, which is gripped by an ordinary (penny) American spring clothes clip.

At B is shown a small piece of sheet lead bent to form a kind of double C with a narrow groove left open at the junction of the two curves. Into this groove we may insert the stem of the specimen and turn the lead strip on edge as shown at C.

At D we have a small block of kitchen soap. In this is made a hole with a brad-awl. Into the hole is inserted the petiole of a leaf. The soap is pressed up firmly round this and affords us a firm holder.

In Figure 77 we see a very useful thing for the botanist, viz.: a test tube on foot, cost one penny or twopence, according to size. At A is a light specimen held in the mouth of the tube by means of a strip of blotting paper wrapped round the stem end and plugged into the tube. As these tubes are quite light they are easily upset, therefore in all cases it is advisable to weight the base end by means of a strip of sheet lead, C, folded round the glass tube.

For a succulent stem, *e.g.*, wild hyacinth, it is a good plan to push up from the cut end into the stem a fine steel knitting needle and then insert the free end into a block of soap, Figure 76 D.

FIGURE 78.

FIGURE 79.

Figure 78 shows us a method of utilising an ordinary funnel stand and spring clip for holding a stem at a certain angle.

Figure 79 shows a very useful and yet simple plan for holding small things like buds, seeds, and so on. This holder is equally useful for the horizontal or vertical camera. An ordinary glass-headed steel pin, one to two inches long, is passed upwards through the cork of a bottle and the pin point used for holding the specimen.

When working with the vertical camera, the background paper is laid on the top of the cork and the pin passed through it. To prevent misunderstanding, perhaps it should be said here, once for all, that while I now show the various holding contrivances, yet when one is actually photographing the specimens one, of course, does not show any part of the holding contrivance, whatever it may be.

F. C. LAMBERT, M.A., F.R.P.S.

ROYAL MICROSCOPICAL SOCIETY.—December 20th, H. G. Plimmer, Esq., F.R.S., President, in the chair.—Mr. Rousselet described a reflecting microscope, by John Cuthbert, which had been presented to the Society by the Committee of the Quekett Microscopical Club. Mr. Rousselet traced the history of the reflecting microscope from 1672, when Isaac Newton first suggested its construction to the Royal Society, down to 1827–8, when Cuthbert, at the suggestion of Dr. Goring, produced the design exhibited.

Mr. F. Shillington Scales, M.A., M.B., F.R.M.S., gave a lecture on "The Photomicrography of the Electrical Reactions of the Heart." He described the principle and construction of the Einthoven string galvanometer, with especial reference to the optical arrangements and the methods of photographing the movements of the wire resulting from the differences in potential set up by the heart-beat. He described the methods of connecting the apparatus to a hospital and the various sources of error that needed to be guarded against, and showed many actual photomicrographs of the movements of the human heart recorded by this method. Photomicrographs of the movements of the hearts of various animals under the influence of drugs were also shown.

Rev. Hilderic Friend, F.L.S., F.R.M.S., read a paper on "British Tubificidae." The author first gave a brief historical sketch, alluding to the work of Lankester, Beddard and Benham and the various Continental and other authorities, who have in past years written on the Family. After showing the difficulties attending definition, and the value of the setae for the purposes of classification, the author proceeded to arrange the British species in two classes: (1) Those genera which are destitute of capilliform setae, and (2) those which possess them. These two groups are again sub-divided, and no fewer than thirty species, besides some sub-species and varieties, are placed on record, of which ten are described for the first time, and sixteen have been added by the author during the year. Specially interesting is the discovery of a new genus, named *Rhyacodrilus*, containing two species, of which one (*R. bichactus* Friend) is new to science. These two species are as yet known only in Derbyshire. *Ilyodrilus* is now definitely recorded as British with no fewer than five species.

A REVOLVING MICROSCOPE TRAY.—As already mentioned, Messrs. W. Watson & Sons exhibited a new tray at the Public School Science Masters' Exhibition, which is useful when a number of students or others wish to look at an object placed under a microscope. The tray on which the micro-

scope is placed (see Figure 80) is fastened to a pivoted block, which carries the lamp and travels on "domes of silence," and when it is moved the lamp moves with it and the lighting is not disturbed.

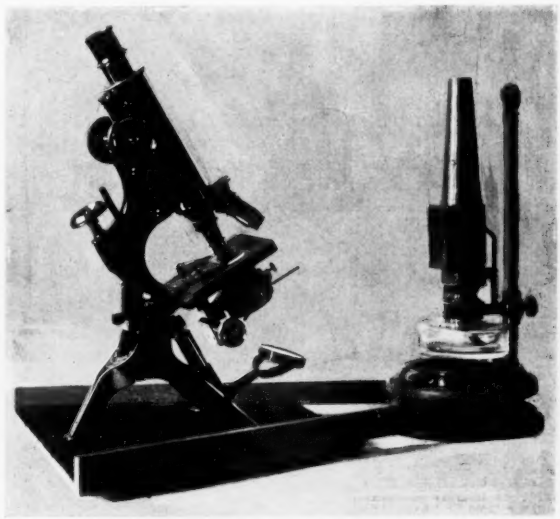


FIGURE 80.

A new Microscope Tray.

NEW MICROSCOPES.—A new series of five Microscopes has just been brought out by Messrs. James Swift and Son. The instruments are identical, except for the stages, which range from the simplest to the most comprehensive. The first in the series has a plain rectangular stage with spring clips, the second has a vulcanite-covered centring rotating stage, the third, which is shown in Figure 81, is of the ordinary mechanical type, now so very widely in use, the vertical movement of which is actuated by a fine rack and pinion, and the horizontal by a steel multi-thread screw. Both movements have verniers which read to one-tenth of a millimetre. The opening in the top plate is so set that it is impossible for the stage to run foul of the condenser. The next stand in the series is fitted with the firm's "I.M.S." Mechanical Stage, which gives thirty millimetres range vertically, and is so designed that the entire surface of a three inches by one inch slip can be systematically examined. This is accomplished by giving the horizontal screw movement a range of two and a-half inches and allowing of the fingers which grip the slide being moved against a vernier half an inch on either side of the normal central position. These fingers are not dependent upon a spring to hold the slide, but are pressed against it by small milled heads. By undoing a small clamp screw the horizontal movement can be entirely removed, leaving a large flat stage suitable for accommodating a Petri dish. The last instrument in the series has this same "I.M.S." stage, but it is mounted on a centring rotating base with clamps to all movements, and so is provided with every adjustment which it is possible to incorporate in a microscope stage.

The particular microscope illustrated was built at the suggestion of Professor Herbert Jackson, of King's College, London, for the use of a research chemist and analyst. For this reason it is fitted with a swing-out polariser and a Glan-Thompson prism analyser in the body, so mounted that it is capable of complete rotation.

The fine adjustment fitted to these stands is actuated by two milled heads, one on either side of the limb, that on the right carrying a divided drum, each division of which is equal to a movement of the body of ·001 millimetre. The movement of this adjustment is stopped at each end and a range of three millimetres is allowed. Special attention has been given to the design of the adjustment, so that it is an impossibility for it to shew any sign of loss of time, or slackness on suddenly reversing the direction of its travel. The entire mechanism of the fine adjustment is contained in a cavity milled out of the solid phosphor-bronze limb of the instrument, which is so shaped that it can be conveniently lifted by the back without tension or strain being put on to any critical part.

The substage is focussed by means of a rack and pinion. It has complete centring adjustments and the portion which carries the condenser can be swung aside out of the optic axis.

The inclination axis is placed well above the stage, so that when the instrument is brought to the horizontal position or inclined, the equal distribution of weight on either side of the centre of gravity renders it exceptionally steady and rigid.

Throughout this whole series Messrs. Swift have adopted solid ground-in slides and fittings, in place of the sprung fittings which, on account of want of stability and life, they gave up some years ago.

THE PHOTO-MICROGRAPHIC SOCIETY.—It may interest those who combine the camera and microscope to know that the above recently-formed society is now established on a firm basis of membership, craftsmanship and enthusiasm. At the moment of writing there are nearly fifty members, and at each meeting additions are being made. The meetings are held on the second Wednesday of each month, at 8 p.m., during the winter end of the year, *i.e.*, October to April, both inclusive. The annual subscription is five shillings, the place of meeting the Gardenia Restaurant, Catherine Street (next door to Drury Lane Theatre, on the Strand side). At the September meeting Dr. Rodman gave an able lecture, showing that photo-micrography covered a very wide field of work; that it need not be an expensive hobby; that ordinary photographic and microscopic apparatus could readily be adapted for the

FIGURE 81.

A new Microscope by Swift.

work by any average handy man; and that even high magnification work presented no real difficulties that a modicum of care and patience could not overcome. The second discourse

was by Mr. F. Martin-Duncan, who dealt chiefly with low-power work, and he also abundantly showed the ease and fascination with which seashore and wayside objects could be made to yield endless variety and infinite interest. At the third meeting Dr. J. Duncan Reid went very fully into the all-important matter of illuminating the object by axially-transmitted light, illustrating several varieties of arrangement of collecting lens, substage condenser, and so forth, by diagrams and actual demonstration. This classic discourse has just been published in the pages of *The English Mechanic*, January 18th, where a reproduction of Dr. Reid's typical diagram, duly drawn to scale, may also be seen.

At the next meeting, on February 14th, Mr. A. E. Smith will deal with stereoscopic work with camera and microscope. (The precise title has not yet been announced.) Anyone interested in photo-micrography should place himself in communication with the honorary secretary, Mr. J. G. Bradbury, 1, Hogarth Hill, Finchley Road, Hendon, N.W. It may, perhaps, be of interest to state that the Society owes its origination to one of the contributors to the pages of this journal, viz., the Rev. F. C. Lambert, M.A., F.R.P.S., who has been elected the first president of the new society, which has our congratulations and good wishes.

ORNITHOLOGY.

By HUGH BOYD WATT, M.B.O.U.

BIRDS NESTING IN ENGLAND IN DECEMBER.—Mr. H. H. Wardle reports that a brood of young thrushes, fully fledged, was found near Runcorn, Cheshire, on December 20th, 1911. He remarks that December broods are not of rare occurrence and gives the following instances (collected from various sources) for the winter of 1908-9 (a mild and open season) :—

Dec. 1.—Sparrow, young, newly-hatched, Tunbridge Wells.
,, 11.—Starling, four eggs, Standon.
,, 12.—Starling, young fledged, Cark-in-Cartmel, Lancashire.
,, 20.—Robin, three eggs, near Mansfield.
,, 22.—Thrush, four young, near Devizes.
,, 22.—Thrush, two eggs, near Lancaster.
,, 22.—Starling, young about to fly, Chester-le-Street.
,, 24.—Starling, three young, fully fledged, near Wigton.
,, 24.—Robin, three eggs, Brooklands, Cheshire.
,, 29.—Starling, young, half-fledged, Stockbridge.
,, 29.—Starling, three eggs, Stainmore Fells.
Jan. 3.—Robin, three eggs, Overton, Hants.
,, 5.—Thrush, four eggs, Quarry Bank, Market Drayton.
Jan. (third week in).—Moorhen, young birds, Botley, Hants.
(*The Field*, December 30th, 1911, page 1447.)

The frequency of the occurrence of the Starling in the above list is further evidence of its adaptability and vigour in pushing to the front.

PENGUINS BREEDING.—The nesting of introduced species kept in confinement is, of course, a different thing; but it is interesting to know that a pair of black-footed or Jackass Penguins (*Spheniscus demersus*) hatched out two young in the Zoölogical Gardens, London, in November last. These birds are winter breeders in a wild state, nesting on islands off the Cape in May and June, with which months our winter, of course, corresponds. When they nest in the "Zoo" in our spring or summer months their eggs are rarely fertile, but they generally succeed in hatching and rearing their young when they nest in autumn or winter, as in the case under notice. Birds from the Southern Hemisphere, unless conforming to our seasons here, fail generally in their nesting efforts.—(D. Seth-Smith, *The Field*, November 25th, 1911, page 1176.)

FURTHER NEW BRITISH BIRDS.—This month one new species and a sub-species are chronicled, and also another species which has been hitherto included in the British list only on the strength of one record and not accepted as unimpeachable. The new records are:—

PINE BUNTING (*Emberiza leucocephala*) AT FAIR ISLE.—Mr. Wm. Eagle Clarke received a male bird in full winter plumage, taken at Fair Isle, on October 30th last, amongst a rush of winter migrants. It is a native of Siberia, wintering in North China, Mongolia, Turkestan and the Himalayas, and is only a straggler in Europe, never having been known to visit the British Isles before. (*The Scottish Naturalist*—January, 1912, page 8.)

THRUSH NIGHTINGALE (*Luscinia luscinia*) AT FAIR ISLE.—This "waif" (of whose occurrence in Britain there is only the one record referred to above, which was at Smeeth, Kent, on October 22nd, 1904), turned up at Fair Isle during the spring migration of 1911, "in company with a crowd of birds of passage," and was secured on May 15th. The species is sometimes called the "Sprosser," and its summer range is from Denmark to south-western Siberia, its winter quarters being in Eastern Africa (*Loc. cit.*, page 9.)

NORTH AMERICAN PEREGRINE IN ENGLAND.—The American form of the Peregrine Falcon (*Falco peregrinus anatum*) has recently been identified as occurring in England, and some particulars, with a photograph, are given in *British Birds* for January, 1912 (V. pages 219–21). One bird was netted on September 28th, 1910, in plover-nets, at Humberstone, Lincolnshire. Another bird, shot nineteen years earlier near Market Bosworth, Leicestershire, on October 31st, 1891, was shown at a meeting of the British Ornithologists' Club on June 14th, 1911. Both are considered to be young specimens of the above-named form, and are new records, not only for the British Isles but for Europe. Its breeding quarters are from the sub-arctic regions of Canada and western-central Greenland, southwards to some of the United States; wintering from southern British Columbia, Colorado and New Jersey to the West Indies and Panama, and occurring in southern South America. Its great powers of flight are considered to account for its appearance in England, and we suppose that the reporters of the above are satisfied that the birds were not "escapes" from confinement.

THE SCOTTISH NATURALIST.—This is an old title revived in place of the somewhat ponderously named *Annals of Scottish Natural History*, the last-named being now dropped and incorporated in a new monthly called *The Scottish Naturalist* (Edinburgh: Oliver & Boyd. London: Gurney and Jackson. Annual Subscription, 6/6). It is devoted to Zoölogy alone, and ornithologists will particularly value it as a medium for reporting the work and bird studies so enthusiastically pursued in the North.

BIRDS NEW TO SCOTLAND.—The first number contains an account of the recent occurrences of as many as five different species for the first time in Scotland, *viz.*, the Pine Bunting and Thrush Nightingale (both new to Britain, see above), and Baird's Sandpiper (*Tringa bairdii*), Woodchat Shrike (*Lanius pomararus*) and Serin Finch (*Serinus serinus*). There are also a number of bird notes from well-known observers.

ZOÖLOGICAL LITERATURE.—Going further afield than Scotland, a new feature promised is a section devoted to short notices of recent literature in all branches of British Zoölogy. This department is much neglected at present by our natural history magazines, and, if well done, would be most useful. It is to be hoped that a serious effort may be made to attain complete records. If the section could take the form of a subject-index to current British zoölogical literature, it would indeed be a boon to readers and students. May it be so.

BIRD-FLIGHT THEORIES.—In a series of articles in *Flight*, Mr. E. H. Hankin M.A., D.Sc., has recently been giving the result of his extended and minute observations of the flight of large birds (vultures, and so on), in India. Apart from the scientific value of his keen and carefully recorded observations of all varieties of bird-flight, the conclusion to which he came regarding the mystery of soaring flight has attracted much attention. By his investigations he disproved (or at least showed good reason for disbelieving) every theory hitherto advanced to explain the soaring flight of

birds. He found also that the birds cannot soar if the sky is densely overcast; either direct sunshine or at least good sunlight are necessary. His conclusion is that the sunlight stores up in the air some form of potential energy which by the passage of the bird's wings becomes liberated as kinetic energy and gives the sustaining power. Minute explosions or molecular bombardment are terms which express the idea of the liberation of the energy. To this supposed allotropic form of the atmosphere Dr. Hankin gives the name of "ergaer." People who have not followed his record of observations and careful scientific reasoning may be inclined to smile, but he makes a good case, and points to lines of original research which his idea—really a working theory—opens out. Mr. Hankin lectures to the Aeronautical Society of Great Britain on January 22nd, and he may then possibly say something more on his "ergaer" theory.

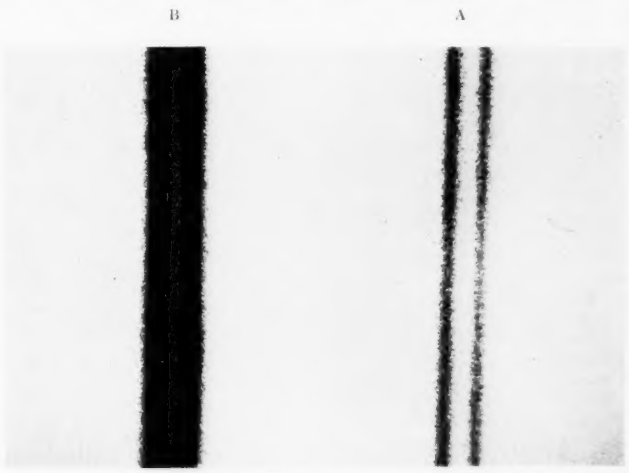


FIGURE 82.

PHOTOGRAPHY.

By EDGAR SENIOR.

FURTHER NOTES ON PRINTING WITH IRON SALTS.—In "Notes" of last issue the method of iron printing described gives white lines on a blue ground, "unless a negative be employed," in other words, the prints themselves are negative ones. This is not always desirable. As to whether the prints produced are negative or positive depends upon whether the agent used to develop the blue compound reacts with the altered or unaltered salt. In the case already considered, the blue compound results from the reaction of the potassium ferricyanide (red prussiate of potash), with the ferrous salt produced by the action of light. If, however, potassium ferrocyanide (yellow prussiate of potash) be used instead, the blue compound results, from its action upon the unaltered (ferric) salt forming the compound known as Prussian blue Fe_4 $(Fe\ Cy_6)_3$. Advantage is taken of this for obtaining positives from positives direct. In order to carry this out in practice the following solutions are made, and the mixture applied to well-sized paper in a subdued light:—

1.

Ferric chloride	34 grains.
Tartaric acid	17 „
Sodium chloride	13 „
Water	1 oz.

2.

Gum-arabic	107 grains.
Water	1 oz.

These two solutions are mixed and then applied to the paper by means of a brush in as even a manner as possible, and dried quickly in front of a fire in order that they shall not sink into the pores. The printing may be done in sunlight in a few minutes, or in diffused daylight for a correspondingly longer time, but a little experience soon enables one to judge by appearance when the printing has been carried far enough. To develop the print a strong solution of potassium ferro-cyanide is used, floating the exposed surface upon the solution, care being taken not to wet the back. When fully developed, float on clean water for a few minutes and then immerse in a ten per cent. solution of hydrochloric acid for a short time and then thoroughly wash. If the ground is stained blue the print has been under-exposed probably, and with care the white portions should be quite free from any blue colouration, the gum being used in order to insure this. With over-exposure, however, it frequently happens that the ground is stained a light blue tint, due to the potassium ferrocyanide giving with ferrous salts a bluish-white precipitate of potassium ferrous ferrocyanide of the following composition (K_2 Fe″ Fe Cy_6). In some instances, it has been found advantageous to print through the paper, in which case the object being copied must be placed in its proper aspect with regard to left and right, otherwise the print will be reversed.

FIGURE 83.

SPREADING OF THE IMAGE OF FINE LINES.—Anyone who has done much work in the photographing of fine lines, or structures of that kind, must have noticed the general thickening-up which takes place, rendering the image coarser and unlike the original in appearance. This is well shown in the accompanying illustrations, which are photo-micrographs enlarged sixty diameters. In Figure 82 *a* we have the enlarged image of two fine lines separated by a distance of $\frac{1}{250}$ millimetre ($\frac{1}{500}$ in.), and in Figure 82 *b* an image of the same two lines from a negative that had received double the exposure of *a*. It will be seen that not only has the space between almost entirely disappeared by the prolonged exposure, but that the spreading has extended to the outer edges as well, to such an extent that the total increase in the width of *b* as compared with *a* is nearly three millimetres in the enlarged image.

In two other photographs on the same plate, in which the exposures had been further increased by doubling each time, the separation between the lines had become quite closed up and still further spreading occurred, so that two fine lines had become one thick one. It may be argued that this case

is exceptional, since lines separated by $\frac{1}{3000}$ in. cannot be resolved by the unaided eye, but the tendency to close up is always present and selecting something with very small distances apart tends to show more clearly the phenomenon. It is also found that the spreading varies with different plates; in one instance the variation between a collodion plate and the same image taken on a gelatine one, amounted to a difference of $\frac{1}{10}$ millimetre in favour of the collodion even although this had been intensified. In Figure 83 is shown the result of doubling the exposure in taking the photo-micrograph, from which it will be seen that the lines are tending to become thinner, due to the extra length of exposure given in the taking of the photo-micrographs. These examples should be of interest as illustrating the great care necessary in photographing subjects of this nature.

PRINTING WITH SALTS OF CHROMIUM.—The following printing process, due to the investigation of Robert Hunt, and announced by him in 1843, under the name of "Chromatype," deserves attention owing to its simplicity together with the good results obtainable by its means. Well-sized paper is washed over with a solution of copper sulphate, and when dry coated with a fairly strong solution of potassium bichromate. The paper when dry may be kept for a short time ready for use. In order to employ this paper, it is placed with the object or objects upon it, in a printing frame and the whole exposed to light for a sufficient length of time to render the paper almost white, when a yellow positive on a white ground results. On removal from the printing frame the paper is floated upon a solution of silver nitrate when the parts that have been unacted upon by light at once assume a dark purple-red colour from the formation of silver bichromate. To fix the images the prints are well washed in distilled water free from chlorides, as these latter have a destructive action, even when present in small quantity. Prints produced by this method appear to be stable, not undergoing any change when exposed to strong light for a considerable time.

EXPOSURE TABLE FOR FEBRUARY.—The calculations are made on the actinograph for plates of speed 200 H and D, the subject a near one and lens aperture F16.

Day of the Month.	Condition of the Light.	Time of Day. 11 a.m. to 1 p.m.	10 and 2	3 p.m.	Remarks.
Feb. 1st	Bright	·25 sec.	·3 sec.	·6 sec.	If the subject be a general open landscape take half the exposures given here.
,, ,,	Dull	·5 ,,	·6 ,,	1·2 ,,	
Feb. 15th	Bright	·2 sec.	·25 sec.	·4 sec.	
,, ,,	Dull	·4 ,,	·5 ,,	·8 ,,	
Feb. 29th	Bright	·15 sec.	·2 sec.	·3 sec.	
,, ,,	Dull	·3 ,,	·4 ,,	·6 ,,	

PRINTING WITH COBALT OXALATE.—This process, originally devised by Messrs. Lumière, is capable of giving very fine results. Unfortunately, perhaps, a certain amount of skill in chemical manipulation is necessary to carry it out successfully. It is based upon the action of light in reducing cobaltic oxalate to cobaltous, and this on suitable treatment is made to yield an image finally in sulphide of cobalt. In our first experiments cobaltous hydrate was suspended in water, through which a current of chlorine was passed, until a black precipitate of cobaltic hydrate was formed, and to ensure the action being complete caustic soda was also present in the water as well. The black precipitate was then carefully washed and dissolved in a calculated quantity of oxalic acid, it being of importance not to have an excess of acid. The formation of the oxalate should be gradual, and the operation allowed to go on in darkness. The dark green solution of cobaltic oxalate was then employed to sensitize gelatine-coated paper, which must be used as soon as dry. The printing under a negative is fairly rapid, the colour of the paper changing over the parts exposed to light to a pale rose tint, due to the formation of cobaltous oxalate. The prints on removal from the printing frame are treated with a 5 % solution of potassium ferricyanide, which deepens their colour; they are then washed in running water for about thirty minutes, after which they are placed in a dilute solution of ammonium sulphide for times varying with the colour desired. A short immersion gives a sepia, a prolonged one black. A final washing completes the operations. A simplified method of preparation of the oxalate consists in treating cobalt sulphate with soda peroxide (Na_2O_2), adding the latter gradually and keeping the solution well cooled to prevent decomposition. The precipitate is then well washed to free it from soda sulphate, and dissolved in a calculated quantity of oxalic acid as before.

PHYSICS.

By ALFRED C. G. EGERTON, B.Sc.

SILICA.—Fused silica is now used largely in place of glass and porcelain for vessels which have to stand heat without risk of cracking. It possesses an exceedingly small coëfficient of expansion. Consequently, when suddenly heated the mechanical forces set up in the material owing to the expansion are not great enough to cause cracking, as in the case of similar bad-conducting substances with large coëfficient of expansion — such as glass or porcelain. It is eminently suitable as the material for a primary standard of length. It is cheaper than platinum or iridio-platinum, and is not so greatly affected by change of temperature as silica. It has a coëfficient of expansion seventeen times less than that of platinum. Invar, the nickel iron alloy, which possesses a smaller coëfficient of expansion than any other metal, is not so suitable a material as silica for a standard of length. Dr. G. Kaye has prepared a standard metre from silica. It consists of a tube of silica with slabs of the same material fused into its ends. The slabs are optically worked planes, and platinised on the underside; the platinum film is then ruled with a diamond so as to give the defining lines between which the standard length is measured.

It will be remembered that the standard metre is the distance between two marks on a bar of platinum which is preserved at the International Bureau of Metric Standards, Saint Cloud, near Paris. It was originally made to be as nearly as possible equal to one ten-millionth of a quadrant of the earth from equator to pole. However, it is now known that the length of the standard metre is not exactly the ten-millionth of the earth's quadrant, but this latter is equal to 10,001,472 metres.

Although the standard metre, and, in fact, any such arbitrary standard that is based on the length of a certain piece of metal, might alter in the course of ages owing to certain cosmic changes, yet they can always be checked against the lengths of certain waves of light. Different elements give out light of different wave lengths; each element has its own characteristic spectrum. One can choose some special element and then choose some special wave-length of light, given out by that metal and find how many such wave-lengths make the standard metre; thus the standard of length can be expressed in terms of the wave-length of a certain line in the spectrum of a certain metal. This has been done by Professor Michelson, for the red line given by the metal cadmium.

The manufacturers of vessels of fused silica have so perfected their processes that the most complicated apparatus can now be obtained, and it is an economy to buy apparatus which is to be subjected to sudden changes of temperature made of silica rather than glass or porcelain. Silica is not attacked by acids, with the exception of hydrofluoric acid. It melts at about 1,600° C. It is harder than ordinary glass. Above 1,000° it is permeable to hydrogen. It is also readily permeable to helium, and recently Professor O. W. Richardson has shown that neon can penetrate through the walls of a tube made of silica, though less easily than helium. It expands regularly up to nearly 1,000° C, and is exceedingly well suited for making high temperature mercury thermometers, which register temperatures up to 700° C, the mercury being under pressure. Owing to its small coëfficient of expansion, silica is a convenient

material of which to make a specific gravity bottle, or pyknometer. A pyknometer is a small tube drawn out to a tube of fine bore at each end; one of these fine tubes is bent round so as to form a U tube, with the tube of larger bore as one of the limbs of the U. The apparatus is weighed, full of water up to a certain mark on the small tubes, and also full of a liquid of which it is required to find the density. From the two weighings a measure of the density of the liquid is obtained, provided proper precautions are taken for observing the temperature. When using a glass pyknometer it is often necessary to take account of the expansion of the glass itself, but with a silica pyknometer this is not necessary; while the latter are much easier to clean and dry, because they can be heated strongly without fear of cracking.

Silica is an excellent insulating material for electrical instruments. Glass adsorbes water on its surface; this water dissolves the silicates of the glass, and forms a conducting layer on the surface of the glass; unless very dry glass is a poor conductor, but silica has not got this defect.

Professor Strutt some years ago constructed a tube of silica in which to measure the electrical conductivity of mercury at high temperatures. The quartz tube was the shape of an inverted Y. The tube was nearly completely filled with mercury. Wires led into the two limbs of the Y tube, and were sealed in with wax. The junction of the limbs of the Y was strongly heated. At a red heat the resistance of the mercury was about doubled. Mercury boils under atmospheric pressure at 356°·7 C. By heating it in a closed quartz tube of the above description it was possible to keep it in the liquid form well above this temperature, and thus obtain red-hot mercury. It was not possible, without bursting the tube, to reach the critical point, at which temperature the mercury would go over from the liquid to the gaseous condition, and above which it would not be possible to obtain liquid mercury. It appears, though, from the experiments that the electrical resistance of liquid mercury would be the same as that of the mercury vapour at the critical point.

ZOÖLOGY.

By PROFESSOR J. ARTHUR THOMSON, M.A.

IS LEFT-HANDEDNESS HEREDITARY?—This question has been recently studied by Professor H. E. Jordan. The cause of left-handedness remains obscure, though it may be regarded as a congenital asymmetry such as is common in organisms. There is much to be said for Sir D. Wilson's conclusion that left-handedness is associated with a greater development (preponderant size and weight) of the right cerebral hemisphere. As we have previously remarked in these Notes, the percentage occurrence in various races is not known with any accuracy. The anatomist Hyrtl puts it at two per cent. among the civilised races of Europe, which is not far off what it was long ago among the warriors of the tribe of Benjamin. It is important to distinguish between structural asymmetry (difference in size and weight), and functional inequality (difference in deftness). It is not less important to try to distinguish between a constitutional tendency and the result of education. Thus most parrots receive with the left foot, but that is because they are ordinarily approached in feeding with the right hand. When the left hand is consistently employed in the feeding, the parrot responds with its right foot. Jordan has investigated seventy-eight lineages in which left-handedness was noted in a survey of about three thousand individuals, and his facts go to show that left-handedness is hereditary. But they do not throw any light on the mode of the inheritance. Left-handedness does not even appear to follow Mendelian principles of inheritance, but the data are somewhat limited. So far as they go they merely yield the conclusion that left-handedness is in some way hereditary.

INTER-SPECIFIC AND INTRA-SPECIFIC STRUGGLE FOR EXISTENCE.—In a report on a recent visit to Cavilli Island, one of the Philippines, Mr. Dean C. Worcester has the following vivid passage which well illustrates the struggle for existence between antagonistic species, and also, in a way, the struggle for existence between members of the same species. The actors were the red-legged boobies (*Sula piscator*), related to our gannet, and the frigate birds (*Fregata aquila*). "Just before dusk, as we were leaving for the steamer, we witnessed an extraordinary scene. Large numbers of red-legged boobies which had apparently been fishing all day, began to return, bringing fish to their nesting mates and to their young. The frigate birds promptly formed a skirmishing line and, singly or in pairs, attacked all comers, compelling them to give up their fish. Some of the boobies, possibly sophisticated individuals which had learned wisdom by experience, actually handed their fish over to the frigate birds and so escaped without much drubbing, but less experienced or more obstinate individuals, which at first refused to disgorge, were vigorously punished until they changed their minds and threw up their fish which were most adroitly caught in the air by their piratical enemies. In one instance, two frigate birds set upon a booby, one of them attacking him from above, and the other flying below to catch the fish which he dropped, and getting five out of seven. Soon the incoming boobies began to arrive in flocks, and the frigate birds were not able to set upon them all, so that many individuals got through to the island. Once among the trees they were left in peace."

WARNING COLOUR IN A CHAMELEON.—Cyril Crossland records the fact that a chameleon can frighten a dog by its rapid change of colour. It was a fox terrier's attack that he watched. The chameleon tried to run away, but it is not good at that! "In a few seconds the impossibility of escape seemed to reach the animal's brain, when it at once turned round and opened its great pink mouth in the face of the advancing foe, at the same time rapidly changing colour, becoming almost black. This ruse succeeded every time, the dog turning off at once." In natural leafy conditions the startling effect would be much greater,—a sudden throwing off of the mantle of invisibility and the exposure of a conspicuous black body with a large red mouth.

LIFE OF TISSUES REMOVED FROM THE BODY.—Everyone knows that a piece of a branch or a piece of a potato-tuber will remain alive for a considerable time after it is cut off, that posts of wood driven into the ground sometimes burst into leaf, that a small fragment of many a plant, from liverwort to begonia, may grow into an entire plant. Similarly, among animals, the excised heart of a turtle, in appropriate conditions, will continue beating for several days after the bulk of the animal has been made into soup, and has passed into a new incarnation. A fragment of sponge, of hydroid, of sea-anemone, of certain worms, and so forth, can regrow the whole. We should like to have more information in regard to the limits of these experiments. In the case of Hydra it has been found that the regenerating fragment must not be very small (a quantitative limit) and that it must contain samples of the different kinds of cells in the body (a qualitative limit). Professor H. V. Wilson has recently shown in regard to some sponges that they may be minced and strained through a cloth strainer,—and yet the debris poured out in an appropriate place will develop into a proper sponge. Of late, too, interesting experiments have been made in keeping pieces of tissue alive in suitable media outside the body. What happens in most cases is that they flourish for a time (three to fifteen days) and then cease growing and die. It has been suggested, however, that the death may be rather contingent than necessary. It may be due to the accumulation of waste-products. So Alexis Carrel has devised a system of artificial rejuvenescence, washing the tissue from time to time with "Ringer's solution," and placing it in a medium of plasma and distilled water. A piece of connective tissue revived nine times—staving off senescence and death, and was growing actively thirty-four days after its removal from the body.

FOSSIL WASPS' NESTS.—The geological record, whose imperfections are so often proclaimed, has also its surprises. We have just been reading a description given by Professor Anton Handlirsch of some hazel-nut-like bodies from the upper Oligocene of Flörsheim. They occurred along with snails'

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shells, insect larvae, lizards' eggs, and mammalian remains. After a discussion of other possibilities the conclusion arrived at by Handlirsch is that the bodies in question are the nests of a solitary wasp, allied to the common *Eumenes pomiformis*, but twice or thrice as large. The walls of the nests are made of clay with some grains of calcareous sand, and the characteristic entrance is quite clear.

TADPOLES IN SEA-WATER.—It has been usually believed that amphibians have a natural antipathy to salt water, but some observations which Mr. A. S. Pearse made at Manila during last summer show that there are exceptions to this generalisation. He quotes Dr. Gadow's words: "Common salt is poison to the Amphibia; even a solution of 1 per cent. prevents the development of their larvae," and then reports that he saw little frogs of the genus *Rana* hopping about on the flats of an *estero* or tidal creek opening into Manila Bay. Two holes made by the crab *Sesarma bidens* were seen to be full of wriggling tadpoles newly hatched. Samples of water from a pool with tadpoles on the edge of the creek were analysed, and it was found that the tadpoles were developing in slightly diluted sea-water, containing as high as 2·096 per cent. of sodium chloride. It seems, then, that both tadpoles and frogs can stand much more than a grain of salt.

HOW DO ANTS FIND THEIR WAY HOME?—F. Santschi has made experiments bearing on this old problem. In the case of some storing ants the pathway is "intentionally" marked by an odoriferous secretion from the worker. The "scent" is followed by others, but it may be supplemented by tactile data. In the case of hunting species, sight may be of importance. It is probable that the eyes make some use of ultra-violet rays. The observer's general conclusion is that the sense of direction in ants is a complex phenomenon, depending on a combination of diverse external stimuli appealing to smell, chemical sense, vision, touch, muscular sense, and even hearing. The problem is simpler in some cases than others, *e.g.*, when the trail is marked by a literal "scent."

INTERESTING ADAPTATION IN A BURROWING CRUSTACEAN.—A. S. Pearse describes the habits of *Thalassina anomala*, an interesting Crustacean which is, in some respects, like a link between the long-tailed Macrura and the hermit-crabs. It is a common burrower on the edges of the Philippine estuaries and makes holes not only in the softer ground but in the hard clay of the grassy meadows. In the latter the holes go down till they are below the water-level. The animal seems to be able to live in poorly aerated water, as Bate surmised long ago from his study of preserved specimens. "Its habits," Pearse says, "are such that this ability would often be of advantage. It possesses an adaptation that is probably for this purpose, that is, the branchiostegites (or gill-covers) are moveable on the dorsal portion of the carapace by a sort of flexible hinge joint. An individual placed in a dish will often move the sides of the carapace in such a manner that it resembles a vertebrate gasping for breath. Such movements would serve to clear the water quickly from the branchial chamber."

LIFE ON THE PLANETS.—Life requires atmosphere, and according to Professor Svante Arrhenius the only planets in our system that have an atmosphere as we have are Mars and Venus. But what a difference between the two! For whereas Venus is beginning to be fit to be a home of life, recalling what the Earth was like very long ago, Mars has almost quite lost what it once had. This, at least, is the view taken by Arrhenius in his recent essay on "The Fate of the Planets."

NOTICES.

AGRICULTURAL EDUCATION.—We are informed by the Presidents of the Boards of Agriculture and Education that the responsibility for Farm Institutes, as well as for the agricultural work of the Universities and Colleges, will be transferred to the Board of Agriculture, and that this Board shall be regarded as the Government Department concerned with this branch of Educational Work for the purposes of the Development Fund.

A NATURE CALENDAR.—A calendar for hanging on the wall, issued by Messrs. George Philip & Sons, contains some interesting suggestions on each of the pages devoted to the months with regard to what can be done in the garden and what is going on in the plant and animal world, so that Nature lovers may find more by looking at it than the mere days of the week and their dates. The price is 6d. net.

GOLD MEDAL OF THE RHODESIA SCIENTIFIC ASSOCIATION.—The Rhodesia Scientific Association's gold medal, recently offered for an original paper advancing the knowledge of the transmission of any insect or arachnid-borne disease affecting Rhodesia, has been awarded to Edward Hindle, Ph.D., A.R.C.S., F.L.S., Magdalene College, Cambridge, Beit Memorial Research Fellow, for his paper on "The Transmission of *Spirochaeta Duttoni*."

A NEW CHEMICAL MAGAZINE.—We extend a cordial welcome to the new monthly journal which Messrs. J. and A. Churchill have published under the title of *The Chemical World*. Its aim is to present to those interested in the many branches of Chemistry an account of progress in both theory and practice, discussing such other matters as may be expected to influence the future progress of this science. *The Chemical World* is edited by Mr. W. P. Dreaper, F.C.S., F.I.C.

THE USE OF THE MICROSCOPE.—Two demonstrations on the use of the microscope and its accessories will be given at the South-Western Polytechnic Institute, on February 12th and 19th, by Mr. E. Senior, from six to seven o'clock in the evening. The matters touched upon will include, among many others, illumination of opaque objects; the determination of the focal length of objectives; the influence of tube lengths and thickness of cover glass on definition; and drawing with the camera lucida.

HOME MUSIC STUDY UNION.—This union has, for several years, arranged annual courses of study to suit various classes of music lovers, and it has also published special articles in *The Music Student*, as well as text books which give information that could not otherwise be readily obtained. Music circles exist in many towns, and there are now forty centres connected with the Union. All information with regard to it can be obtained from the Secretary, 12, York Buildings, Adelphi, London.

PORT ERIN BIOLOGICAL STATION.—The twenty-fifth annual report of the Liverpool Marine Biology Committee has reached us, and as usual contains records of much valuable work on the part of the staff and students. Sixty of the latter occupied the work tables during the year, and a description of the researches carried out is given. The report also includes a list of subscribers, which though a good one, ought to be very considerably extended. The Honorary Director, Professor Herdman, F.R.S., is to be congratulated on the progress of his work.

NOTICE OF REMOVAL.—The Electro-medical business of Messrs. Newton and Company has increased so greatly that it has been decided to form a private limited liability company under the name of Newton and Wright, Limited, which will carry it on at 72, Wigmore Street, W. Mr. H. C. Newton, the senior partner of Messrs. Newton and Company, will become Chairman of the new company, and Mr. R. S. Wright, the junior partner, will be Managing Director. The whole of the shares will be held by the present partners, together with some senior members of the staff, and the *personnel* of the department will remain entirely unchanged.